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TELEPHONE ENGINEER

VOLUME 28 FEBRUARY, 1924 Number 2

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THE INVENTOR AND THE RESEARCHER.

In his recently published autobiography, "From Immigrant to Inventor," Dr. Michael Pupin, inventor of the loading coil, quotes a vice-president of the American Telephone and Telegraph Co. as having said that it is estimated it would have cost at least an additional hundred million dollars to build the telephone system of the country if the loading coil had not been invented.

Dr. Pupin then asks the very natural question, where are the hundred million dollars that were saved. He is positive that it is not in the pocket of the inventor and he has figured out, with the same mathematical accuracy that he used in figuring out the invention, that it is not in the pockets of the telephone company. His conclusion, therefore, is that it is in the pockets of the American public. This invention made it possible to give service at a lower cost than if the additional hundred million dollars had been spent on telephone plant.

Therefore, the inventor of the loading coil very properly considers himself a public benefactor and he calls attention to the fact that most inventions are of vastly more benefit to the public than to the inventors and to the corporations that use them. He then pays a warm tribute to those faithful workers who have spent long hours in the working out of details in the development of his and other inventions. He truly says that "it is not so much the occasional inventor who nurses a great art like telephony and makes it grow beyond all our expectations, as it is the intelligence of a well organized and liberally supported research laboratory."

In making this comment, Dr. Pupin places his finger upon one of the great difficulties of the modern industrial system: How may the obscure worker be given credit for his portion of the development of a great invention or the building up of a great industrial organization? Fortunately for industry and for the public, these workers like Dr. Pupin himself find their reward more in the satisfaction of having had a part in the doing of a great work rather than in the material gain or in public acclamation.

It is interesting to note that Dr. Pupin concludes that this kind of development would never have taken place under government ownership. What life telephony has in Europe is due to American research.

STATE CONVENTION SEASON IN FULL SWING

The season for state conventions is now open. During the months of February and March, nine state associations will assemble for their annual meetings. Interesting programs have been prepared for these meetings. Those who attend are sure to profit. No telephone manager can afford to miss the convention in his own state.

U. S. I. T. A. CONVENTION DATE IS SET

Chicago, Ill.—Dates for the United States Independent Telephone Association have been set as Tuesday, Wednesday, Thursday and Friday, October 21-24, inclusive. Hotel Sherman at Chicago again will be the meeting place.

COMPLETE YOUR CONSTRUCTION PLANS NOW

Throughout the greater part of the country, outside construction work on the telephone plant must, necessarily, be seasonal work. The construction program for each year must stand as a unit, with a certain definite time limit at which it must be completed—or laid over until another year. This situation makes it all the more necessary that a definite plan for the performance and completion of the work be made in advance.

In order that each job may be carried on smoothly and without delay, it must have its definite time in the schedule. Material must be on hand when needed for the work. It must be delivered to the job when needed, and the necessary workmen and tools must be provided. Much delay and unnecessary expense may result if there is a slip anywhere along the line.

Emergency work always must be expected and the schedule must be flexible enough to allow for a certain amount of time for this class of work. Bad weather, delays in delivery of material, shortage of skilled workmen—all take their toll of the all-too-little time available. The effects of all of these can be minimized, however, by careful advance planning and by resourceful management when they do occur.

By this time of year, plans for the spring and summer construction program are, or should be, pretty well completed. Every company knows, or should know, about how much construction and reconstruction work it plans to do during the year. Orders for material should be placed promptly

and provision for its receipt and storage should be made. Then, in the interval between the completion of the planning, and the actual commencement of the work, there will be time for a complete check of the entire program so that it can be started and pushed forward, systematically, just as soon as the weather permits.

USE THE ROUTE BOOK.

In a complex network like the toll line system of the country, there are, frequently, several routes, any one of which will provide a circuit from the originating to the terminating point of a message. Companies operating toll lines have compiled route books to show how traffic between two exchanges should be routed, often giving first and second choice in the routes to be followed. These routes have been laid out carefully in order that the circuit may be built up from facilities that will give adequate service between the terminals.

Frequently, in checking complaints of poor transmission, it is found that the operators have not used the proper routing or have not called for circuits of the class required by the length of the circuit to be built up. The result perhaps is a lost call or a complaint of poor service and a certain loss of confidence on the part of the customer as regards the ability of the telephone company to furnish adequate facilities for his long distance business.

The volume of long distance traffic depends to a certain extent upon the ability of the user to talk easily and to get connections quickly. The loss of a single call may deter him from placing other calls for similar distances. Therefore, the proper use of the route book in building up circuits may influence directly the revenue of the long distance business. It is a matter of enough importance to warrant some attention on the part of those who supervise the handling of toll traffic.

SUBSCRIBER OWNERSHIP

In the annual report of the Lincoln Telephone and Telegraph Co., attention is called to the fact that the company has nearly 2,000 stockholders and that practically all of these live in the territory served by the company. The individual holdings of stock are small; so small, in fact, that the combined holdings of the 200 largest stockholders would be required for control of the company. This is described in the report as approaching the ideal situation where a company is owned by stockholders who at the same time are subscribers to its service. They are getting service practically at cost since any surplus over actual cost of operation is returned to them in dividends.

The Lincoln company has a record of sixty consecutive quarterly dividend payments and the fact that no new financing is planned for the current year, in spite of a large replacement program, is evidence that it has found little difficulty in getting funds for its corporate purposes. It is interesting, however, to note the contention of the management, that a margin which does not permit of an appropriation of 2 per cent to surplus, after dividends are paid, represents too small a margin for proper safeguarding of the property and the service.

The situation of the Lincoln company does much to prove that telephone properties can be financed in the communities in which they operate. Then, too, there is the example of M. L. Golladay's Home Telephone Co., at Holden, Mo., which is described in the news columns of this issue.

Any telephone company with a consistent earning record and competent management can dispose of its securities in the home market. In properties that do not have earning records, the management can prove its competence by placing the company on a dividend-paying basis, and other financial problems then will take care of themselves.

"THAT AIN'T THE HALF OF IT"

"A terrific storm accompanied by wind and sleet, swept the country. . . . The telephone company had many lines down. . . . It is expected that service will be restored on the lines in two or three days." These are very common statements in the papers these winter days. But, as our friend "Billy" of the line gang would put it, "That ain't the half of it." The half that isn't there is the story of twenty-four, forty-eight or seventy-two hours' continuous work without removing cold, wet or frozen garments; of a few moments' sleep when complete exhaustion forbids further driving of tired muscles; of stalled motors, of hikes through snow where no vehicle could go; of snow-blind eyes, of frostbitten cheeks, of fingers bleeding from ice-cuts. Perhaps the day will come when someone will be found to tell this part of the story and those who work in comfortable offices or sit by cheerful firesides may understand the hardships that are undergone by the men of the line in order that the service may not fail.

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Spring Construction Plans

Survey of the Building Outlook in the Telephone Industry for 1924—Situation as Regards Men, Materials and Money Generally Favorable—Rural Communities Not Yet Normal

At about this time each year, it is the custom for TELEPHONE ENGINEER to make a survey of the telephone field, to gather information regarding spring construction plans. Each year, we present several columns of news items, showing the work that is planned by various companies and the expenditures they are planning to make. Information from a large number of companies has been received and is presented herewith. Other reports will follow as plans are matured.

A general survey of the situation reveals the fact that 1924 will follow the precedent of 1922 and 1923 and will be marked by extensive additions to the telephone plant of the country. The demand for service in the larger centers continues at an unprecedented rate and a large amount of cable and switchboard equipment will be needed to provide facilities for growth. In the smaller cities and towns, the rate of growth is not so great but it is likely that a considerable amount of work will be done in order to improve plant conditions. Only in the rural districts and the towns depending upon them is the work likely to lag somewhat. This is caused, not by the fact that much work is not needed, but rather by the continuing unsatisfactory financial condition of the farmer. Present signs point to substantial relief in that direction, however, before the current season is far advanced.

In every other way, there is every reason why construction work should progress in 1924. At present, the rate for borrowing capital is reasonable and there is a considerable amount of money available for investment. The labor supply in most localities is fairly adequate, although this may not continue throughout the year if expected improvement in general business takes place. In general, the supply of material is good and rather prompt deliveries can be obtained, with the possible exception of cable which must be ordered subject to delay. Material and equipment prices are maintaining their level, and little reduction may be expected for several years, if the predictions of experts are to be trusted. The one exception is copper which continues to be very low in price. Taking everything into consideration, there is every reason why 1924 should be a big year in telephone construction.

Citizens Telephone Co., Paris, Ark., W. J. Elsken, Jr., Sec.-Treas; hanging 5500 ft. of 100-pr. cable and laying about 1000 ft. of underground cable.

Russellville Telephone Co., Russellville, Ark., J. E. Armstrong, Manager; planning to rebuild plant, install new switchboard equipment, complete metallic circuits and make the plant all-cable within city limits.

Ocala Telephone Co., Ocala, Fla., D. W. Phillips, Wire Chief; laying two miles of 200-pr. cable; one mile of 50-pr. and several hundred feet of smaller cable. Will use thirty 25-ft. cypress poles; thirty 15-pr. cans; two 50-pr. cans; 540 ft. of 150-pr. cable; 660 ft. of 100-pr.; 1510 ft. of 75-pr.; 2225 ft. of 50-pr.; 700 ft. of 25-pr.

Assumption Mutual Telephone Co., Assumption, Ill., J. A. Fredrick, Supt.; rebuilding of country lines.

Peoples Mutual Telephone Co., Hillsboro, Ill., Walter R. McLean, Gen. Mgr.; reconstruction of two exchanges and rehabilitation of a number of farm and toll lines. Will require poles and other line materials.

Northern Illinois Telephone Co., Mendota, Ill.; E. E. Wallace, Gen. Mgr.: large number of new telephones have been added to the list, which now registers 4500. Revenue was increased about $5,000 over preceding year. Several miles of cable together with new and improved toll lines are planned for the coming year.

Morrison Telephone Co., Morrison, Ill., F. Trautwein, Gen. Mgr.; about 4000 ft. of cable extensions and replacing of some country pole lines. Supplies already ordered.

Automatic Home Telephone Co., Pontiac, Ill., H. R. Wolle, Op. Mgr.; overhauling outside plant.

Forest City Telephone Co., San Jose, Ill., Roscoe Smith, Mgr.; repairing city and rural lines. Will require poles, wire, cable, etc.

Logan Telephone Co., Seaton, Ill., F. L. Logan, Pres.; three to five miles of country lines and two to twelve miles of toll lines, including all necessary poles, wire, etc.

Westfield-Kansas Telephone Co., Westfield, Ill., Roy W. Hall, Mgr.; cutting over a mutual exchange; will require construction material.

Southern Indiana Telephone Co., Aurora, Ind., E. W. Swarthout, Pres.; new cable extensions, requiring 2000 ft. of 100-pr. cable and 4800 ft. of 200-pr. lead-covered cable.

Batesville Telephone Co., Batesville, Ind., Burt M. Schultz, Mgr.; new common battery switchboard.

Eureka Telephone Co., Corydon, Ind., C. C. Wininger, Mgr.; will rebuild entire plant this year.

Western Indiana Telephone Co., Goodland, Ind.; resetting of all pole lines and replacing of some open aerial wire.

Dubois County Telephone Co., Huntingburg, Ind., C. W. Koerner, Mgr.: Will build their own telephone building in Huntingburg this year.

Pendleton Telephone Co., Pendleton, Ind., R. E. Brookbank, Gen. Mgr.; rebuilding five miles of country lines; some new cable work in town.

Wolcott Telephone Co., Wolcott, Ind., W. W. Washburn, Mgr.; general overhauling and a small amount of new building.

Marcus Telephone Co., Marcus, Ia., H. J. Reimers, Prop.: Extensive new lines; will need cable.

Jetmore Telephone Co., Jetmore, Kans., H. E. Puckett, new owner, plans a number of improvements.

Farmers & Merchants Telephone Co., Pawnee Rock, Kans., Lewis A. Chaney, Pres.; will rebuild ten farm lines and erect 1000 ft. of 25-pr. cable; will need a car of poles and the necessary cable, etc.

Pleasanton Telephone Co., Pleasanton, Kans., Samuel Tucker, Mgr.; contemplates burying cable, ranging from 15 to 250 pair; also will rebuild six miles of pole leads; will need poles, cable and accessories.

Clinton Telephone Co., St. John's, Mich., Leslie G. Brown, Mgr.; about $2000 worth of rebuilding; requires cross arms, wire, insulators, torch, etc.

Edgerton Telephone Co., Edgerton, Minn., H. DeBoer, Prop.;600 ft. of underground cable; supplies for same needed.

McLeod County Telephone Co., Glencoe, Minn., Jay Greaves, Pres.; will need a car of 5-in. 25-ft. poles and one of 5-in. 20-ft. poles.

Watertown Telephone Co., Watertown, Minn., Levi Johnson, Mgr.; re-

building rural lines; will need pole line materials.

Holden Home Telephone Co., Holden, Mo., M. L. Golladay, Sec.-Gen. Mgr.; erection of a carload of aerial cable.

Richland Telephone Co., Richland, Mo., E. E. Noe, Prop.; laying about 600 ft. of 75-pr. cable underground; will require the cable, necessary materials for laying it and can top.

Farmers Union Telephone Co., Sussex, N. J., F. E. Armstrong, Mgr.-Sec.; overhauling of lines, including some 25-pr. and 50-pr. aerial cable.

Clayton-Texline Telephone Exchange, Clayton, N. M., F. H. Clark, Prop.; no new building; have had two years of drouth there; has some equipment he would like to sell.

Lincoln Telephone Co., Lincoln, Neb., W. E. Bell, Com. Supt.; remodeling and installation of new equipment involving a half million dollars; also, $175,000 will be spent on new cables.

Ouleout Valley Telephone Co., Franklin, N. Y., E. A. Mackey, Pres.; rebuilding of 20 miles of pole line and 2500 ft. of 50-pr. cable; will need supplies for same.

Black River Telephone Co., Lowville, N. Y., J. J. Domser, Gen. Mgr.; placing about 35,000 ft. of aerial cable and building 20 miles of pole line.

Madison Mutual Telephone Co., Solesville, N. Y., Willard T. Taylor, Sec.-Treas.; rebuilding a large part of the lines; will need cross arms, insulators, brackets, wire, etc.

Subscribers' Service Telephone Co., Woodbridge, N. Y., C. W. Bump, Mgr.; 4-position magneto board, 8000 ft. of cable, 20 circuit-miles of iron wire; will need cable, messengers, wire, cross arms, etc.

Mt. Sterling Telephone Co., Mt. Sterling, O., J. A. Zeeck, Mgr.; regular maintenance work and, probably, also will bury cable this summer, the old cable being in poor condition.

Abbeville Telephone Co., Abbeville, S. C., E. W. Gregory, Pres.; will install a new 1000-line magneto switchboard.

Citizens Telephone Co., Lexington, S. C., Samuel B. George, Mgr.; rebuilding of old farmers' lines; will want No. 14 iron wire, insulators, brackets, twist and a few telephones.

Nansen Telephone Co., Howard, S. D., R. F. Fredericksen, Sec.-Treas.-Mgr.; rebuilding 35 miles of rural line; will need poles, cross arms and line material.

Gibson County Telephone Co., Milan, Tenn.; rapidly getting ready for business; rural lines nearly completed and construction work in Milan progressing rapidly.

Molly's Falls Telephone Co., Marshfield, Vt., A. T. Davis, Sec.; will decide soon regarding season's program.

Hayward Telephone Co., Hayward, Wis., E. L. Harman, Mgr.; 17,000 ft. of 5-pr. paper leaded cable; supplies for same are desired.

Monroe County Telephone Co., Sparta, Wis., Howard Teasdale, Sec.; considerable cable work; will need cable, poles and accessories.

Among others who also have reported plans formulating for work of a general nature this year are: W. M. Speaker, Sec.-Treas. of the Schaller Telephone Co., Schaller, Ia.; A. E. Hodoval, Mgr., Oxford Junction Telephone Co., Oxford Junction, Ia.; Geo. E. Meredith, Mgr., Minden City Telephone Co., Minden City, Mich.; Rolland J. Makibben, Gen. Mgr., Perry County Telephone & Telegraph Co., Landisburg, Pa.; H. A. Woellmer, Mgr., Cayuga Southern Telephone Co., Poplar Ridge, N. Y.; Dallas W. Davis, Sec., Farmers Mutual Telephone Co., Burr Oak, Kans.; B. M. Burnson, Sec., Sheyenne Telephone Co., Pekin, N. D.; S. O. Williamson, Sec.-Mgr., Staunton Telephone Co., Staunton, Ill.; W. L. Cary, Pres., Newark Telephone Co., Newark, O.; R. C. Smith, Sec.-Treas., Calhoun County Telephone Co., Homer, Mich.; Miles Baldwin, Mgr., Russell Telephone Co., Russell, Kans.; E. D. Weeks, Mgr., Kenesaw Telephone Co., Kenesaw, Nebr.; John M. Kramer, Mgr., Marion Telephone Co., Maria Stein, O.; H. E. Rosenow, Sec.Treas., Badger Telephone Co., Oconomowoc, Wis.; John Umflat, Advance Telephone Co., Marble Hill, Mo.; Fayette Home Telephone Co., Lexington, Ky.; Evan Griffith, Mgr., Greaves Telephone Co., Kenmare, N. D.; Al. Trenholm, Sec.-Treas., Home Telephone Co., Georgetown, S. C.; Schoharie Telephone Co., Tannersville, S. C.; F. W. Schafer, Mgr., Ida Telephone Co., Ida, Mich.; L. A. Bowdle, Sec., Inter-County Telephone Co., Cerro Gordo, Ill.; G. F. Green, Prop., Ripon Telephone Exchange, Ripon, Cal.

Minnesota Attracts the "400"

Attendance and Exhibits Have National Aspect

MINNESOTA'S NEW OFFICERS

D. M. Neill, Red Wing, President.

E. P. Wright, Alexandria, Vice President.

J. C. Crowley, Minneapolis, Secretary-Treasurer.

Minneapolis, Minn.—With approximately 400 in attendance at the 15th annual convention of the Minnesota Telephone Association, the meeting was featured by a high-powered program that made the event one of the red letter events of state association activities. The exhibits of many prominent manufacturers gave a decided coloring of the national Independent association's big annual affair.

President Jay Greaves in his address called attention to the fact that some one must be constantly on the job to see that telephone companies are able to make a living despite the restrictions that are placed on a telephone company's investment. The association is discharging this duty ably, he proved, by telling of the inimical legislation which had been knocked out by the state organization's vigilance and efforts. He also referred to the successful district meetings as evidence of the association's helpfulness to its members. Among the association activities to which he pointed was an investigation of the Texas plan with a view to determining its fitness in meeting Minnesota financing requirements. The necessity of a tribunal to sit in inductive interference cases and the burden of certain aspects of the Minnesota minimum wage law places on small telephone companies also were treated in the presidential address.

Essential to betterment of collection activities of telephone companies is a proper understanding by the subscriber of the companies' problems, said F. W. George of the Dakota Central company in his well received papaper on "Collection Methods."

He added that the customer always should be fully informed of the credit limits and penalties, and an uncompromising stand taken by the utility.

An interesting array of addresses having a decided value in the day's work was presented at the Minnesota meeting. Among them were the talk of George Folds of the Cook Electric Co. on "Central Office and Substation Protection," which is digested elsewhere in this issue, the remarks of J. D. Taylor, division transmission engineer for the Northwestern Bell, which was illustrated by blackboard sketches, and the demonstration "In Completing a Telephone Call in Large City," by Miss Adelaide Rogers and others of the Northwestern Bell. Mr. Taylor's talk on transmission losses brought to light specimens of poor wire joints and dirty plugs that hindered transmission.

An offer of a compensation and public liability insurance, provided the

proposition was accepted by a specified number of Minnesota companies, was made by J. E. Scanlan, and taken under advisement by the association.

The advantages of standardization of printed supplies and directories was the subject of the address made by R. M. Woolfolk of the Con P. Curran Printing Co. of St. Louis, who is a nationally known authority on the subject. The advantages enumerated by Mr. Woolfolk were:

"1. The kind of form used for the various purposes, influences and suggests to the employe and the public the general policy and purpose of the company. Therefore, the educational value of uniform practices cannot be overestimated.

"2. The question of uniform accounting methods is one of much importance, particularly since the Interstate Commerce Commission and the state commissions require certain financial reports needed for rate making and other purposes. There are no doubt instances where the companies are rightfully entitled to an increase in rates but cannot satisfactorily prove their case because of inadequate accounting.

"3. The reduction in expense to a surprising degree by means of adopting certain standardized forms, of the same size and wording, is of importance."

F. B. MacKinnon, head of the National Independent organization warned the convention that the public is not paying the rate it should, but that the plant is. "The time has come," he said, "when this must stop." The telephone men had to buckle down and get incisively at work with their own problems and not be diverted by the surge of attention being given community activities by men in this industry.

H. B. Bell, cable tester of the Northwestern Bell, presented an instructive address on cable maintenance and exhibited samples of hardware to illustrate his remarks on correct pole line and conduit construction. Cable trouble testing came in for considerable attention during the discussion which followed the Bell paper. J. C. Nelson of the Western Union spoke on "Relations Between the Telephone and Telegraph," tracing the development of these services and sketchily describing the work, particularly from a construction standpoint, of the two-wire systems today.

A tax reduction program was endorsed and copies ordered mailed to Minnesota's representatives in Congress.

A well attended and lively banquet and dance cared for the formal entertainment element of the successful program.

Plan for South Dakota's Year

Annual Convention Clears Decks for Action

SOUTH DAKOTA'S OFFICERS

L. H. Snyder, White Lake, President.

Charles E. Adams, Croton, Vice President.

Thomas Phalen, Aberdeen, Secretary-Treasurer.

Executive Committee

J. A. Steninger, Parker; J. J. Bollinger, Bridgewater; M. E. Guinter, Sioux Falls; Charles A. Robinson, Scotland.

Mitchell, S. Dakota—Inductive interference, taxation, and switching charges came before the South Dakota annual convention as the three points of major executive interest. The operators, in a lively conference, cared for their own destiny with the added guidance of some expert executive talent.

O. E. Rofelty, manager of the Northern States Power Co., who spoke on "Inductive Interference from the Standpoint of the Power Company," and Charles A. Robinson, superintendent of the Peoples Telephone Co. of Scotland, who handled the telephone companies' side of the case, gave the subject of inductive interference a thorough threshing-out, aided and abetted by those who took part in a spirited discussion. The wind-up revealed that the South Dakota hope for adjustment of difficulties in this direction lay in an amicable consideration of the whole situation from both sides, and that in the burial of the hatchet the first move toward an entirely satisfactory solution of the problem would be made.

Charles E. Hall, tax commissioner for the Northwestern Bell spoke on the "Curb for Mounting Taxes" and was followed by State Tax Commissioner Eveland, who told of the necessity of telephone companies making their tax reports in time to get some action in readjustment, if it were found necessary. The convention went on record endorsing the repeal of taxation on telephone messages.

The paper on "Adequate Compensation for Switching Service Station Companies" by W. W. Straight of Crooks, provoked discussion which resulted in the convention amending the by-laws by adding two members to the legislative committee, empowering them to make studies regarding the cost of furnishing service to service station companies and instructing them to use every reasonable effort to have the present statute repealed which defines the statutory rate which is inadequate compensation for switching service station companies.

J. J. Murphy, chairman of the South Dakota Railroad Commission addressed the convention promising the cordial co-operation of the commission in the advancement of telephone service in South Dakota and of solving the problems that confronted the industry in that state.

One of the features of the meeting was the attention given the manufacturers' representatives on the program. Jay Houghtaling spoke on the relations between Manufacturers and Jobbers and Operating Telephone Companies, and favored a salesman's code of ethics as the foundation of selling practice. Other salesmen who talked before the convention were Messrs. Palmer of Monarch, Harris of Page and Hill and Vayo of Kellogg.

Among those whose remarks added to the interest and instruction of the sessions were Charles Deering, secretary-treasurer of the Independent National Association, A. H. Harris of the Dakota Central and Andrew Marvick of the state highway commission.

The operators' conference was, by common consent, the best that the South Dakota association has experienced. It was conducted by Miss Mamie Schmeiter, toll instructor for the Dakota Central Telephone Co., of Aberdeen, assisted by H. J. Gibbs, chairman of the traffic committee, Miss Mable Willig, toll instructor, Northwestern Bell Telephone Co., of Sioux Falls, and also Miss Easton and Mrs. Hughes of the traffic department of the Northwestern Bell Telephone Co., at Omaha, Neb.

A drill on "Start of Conversation and Correct Timing" was conducted by Miss Mamie Schmeiter. The paper by H. J. Gibbs on "Circuit Loads and Routes" was a valuable and interesting spot in the joint session of the executives and operators. Other features of the joint session were the talks of Thos. Phalen, traffic-commercial supervisor of the Dakota Central Telephone Co., on the subject, "What Makes Public Service a Success," and by L. H. Snyder, of White Lake, on "How to Make Our Operators' Meetings a Success." J. A. Steninger, of Parker, addressed the convention and operators on the topic "How Do Patrons Get an Impression of Our Service?"

LINE AND DESK

SOME QUESTIONS ABOUT 1200-PAIR CABLE.

A valued subscriber and occasional contributor to these columns, recently unloaded upon the editor a group of questions about 1200 cable and its use. His letter is too long to reproduce but the principal questions may be summarized as follows:

1. Would there be cross ringing or induction from harmonic ringing at 16, 33, 50 and 66 cycles with voltages of 100 to 135 volts?

2. Would there be any tendency for insulation to break down causing wires to cross, short-circuit or ground?

3. Would this condition be worse at bends or corners than if the cable were straight for the entire distance?

4. What would be the maximum distance over which such cables could be operated?

5. What would be the transmission value of 24 ga. .12 mf. grounded capaccity, cable? How would it compare with 22 ga. .10 mf. grounded capacity cable?

There is no reason apparent why the cross ringing or ringing induction should be troublesome even with harmonic ringing at the higher voltages. Much 600 pair cable has as high capacity as .12 mf. per mile grounded (.083 mf. per mile, mutual capacity). We have never heard of induction difficulties with harmonic ringing in this type of cable if the insulation of the cable is maintained. Our guess is that by far more ringing induction with harmonic ringing has its source in the storage battery than in the cable, particularly when the so-called "noise killing" circuits are not properly installed or maintained.

There should be no tendency for insulation to break down in 1200 pair cable than there is in smaller sizes. Cables are given a factory test for insulation break-down with 500 volts direct current. This is much higher than the peak voltage of even the highest voltage harmonic ringer. This answer, of course, assumes that no moisture or other cause of low insulation is present in the cable after it has been spliced.

While bends in the cable should be made with as large a radius as convenient to prevent damage to the sheath or possibly to the insulation of the core wires, there is no particular risk of break-down at the bends due to ordinary ringing or talking voltages. Only in the case of lightning or other extremely high frequency and high voltage currents, is there sufficient inductance in a bend or corner to make the current discharge to ground rather than go round the corner. The risk for this cause is about the same in all cables.

The maximum distance for the use of 24 ga. cable is determined by two factors, resistance and transmission loss. If the line has too great resistance the relays will not operate properly and signalling difficulties will result. No. 24 B. & S. ga. wire in cable has an average resistance of about 280 ohms per mile of circuit. Inasmuch as it is usually inadvisable to operate common battery loops of more than 500 ohms resistance it may be seen that the limit from this cause is somewhat under two miles of cable.

In transmission efficiency, one mile of 24 ga. .12 mf., ground capacity, cable is equivalent to approximately 2.1 miles of standard 19 ga. cable (88 ohms, .054 mf., mutual capacity, per mile). The equivalent of 22 ga. cable having the same electrostatic capacity as the 1200 pair cable is 1.66 miles of standard cable. This indicates that the high frequency loss in the 24 ga. cable is about 25% higher than that of the 22 ga. cable of the same capacity. There is another matter to be considered than the high frequency loss. The resistance of the cable in the loop that is transmitting causes a reduction in current supply to the transmitter and, therefore, a further loss in transmission. The resistance per loop mile of 24 ga. wire is 280 ohms while that of 22 ga. wire is 176 ohms per mile. On this account, a No. 24 ga. cable, .6 mile long causes the same reduction in transmission as a 22 ga. cable 1 mile long. Taking both high frequency and current supply losses into consideration it seems that the limiting length of No. 24 ga. cable in a subscriber loop is approximately two-thirds the limiting length of 22 ga. cable. The exact length of the 24 ga. cable that would be permissible might be determined if the allowable transmission loss in outgoing transmission in a subscriber's loop were given.—Staff Contribution.

SEND ALONG YOUR QUESTIONS!

It occurred to us, as we were answering the questions about 1200-pair cable which appear in another column, that this part of our service to readers of TELEPHONE ENGINEER has not been utilized as much as might be. Unfortunately, we are not adept at thought reading and do not know your problems unless you ask us about them. Therefore, we invite you to send along your questions. If we can't answer them, ourselves, we will find someone who can. Other people may have similar problems and will be interested in the answers to yours. Your name will be published, or not—just as you choose.

COMBINATION MAN AS PUBLIC RELATIONS EXPERT.

The combination man in a small town has a great deal to do with our public relation. Whether he realizes it or not, he can exert a good influence on public opinion.

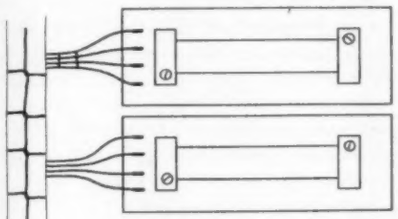
When the combination man first goes to install a telephone, he is making the first and, generally, a lasting impression upon the new subscriber's mind. A great many questions about the business are asked us. Some of them we are able to answer and some we can not. But we always can tell the subscriber where to go or whom to call to secure the information wanted.

We always try to install the telephone just where it is wanted, clean up the disorder that may be caused by our work and make the subscriber feel that we are there to help him become a good telephone user. Thus we impress upon him the character of our service —high grade from his first contact with us.

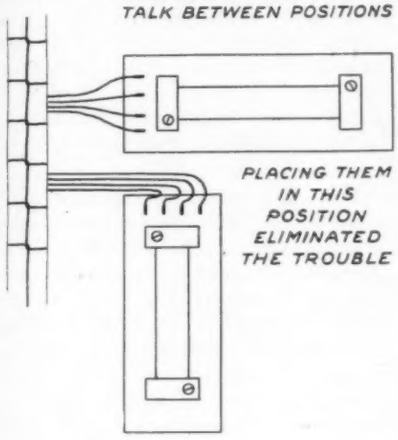
Later, if we have occasion to call to repair the telephone, we nearly always find the subscriber glad to see us, for two reasons—first, because the telephone is to be restored to service, and, second, because he feels that he knows us and has found us to be "pretty decent folks."—*The Mouthpiece.*

A CASE OF CROSS TALK

When I first went to a certain office to take care of the switchboard, I noticed the bad condition of the wiring and equipment in the chief operator's desk and made a note that I would give it an overhauling at the first opportunity. The desk was of rather an old type and was equipped with two operator's positions. In the rear of the cabinet, I found that one of the induction coils had been unscrewed from the mounting board and was hanging loose supported only by the wiring. When I got around to the job of dressing up the wiring, I put



INDUCTION COILS IN THIS POSITION CAUSE CROSS TALK BETWEEN POSITIONS



PLACING THEM IN THIS POSITION ELIMINATED THE TROUBLE

back the screws and straightened up the wires. It was a pretty good job and I felt rather proud when it was finished.

Only a day or two later, a trouble ticket told me that there was cross talk between the two positions. Tests showed that this was the case and I started out to find the trouble. After working on it for some time it suddenly occurred to me that I had had no complaint while the induction coil was hanging loose and I finally figured out that I had created a kind of transformer when I had put the loose coil back in its former place alongside of the coil for the other position. Evidently the man who had removed the screws in the first place, had done it to remove the cross talk and was satisfied when the trouble disappeared. A few minutes work in rearranging the wiring so that the two cores of the coils were at right angles enabled me to clear the trouble and still leave a good job.—Contributed.

A TEST FOR POOR GROUND CONNECTIONS

As a reader of the Line and Desk department of TELEPHONE ENGINEER, I enjoy the articles very much. Therefore, I thought I would tell you of one of my trouble finding schemes which I think is a great help to the man out on the job.

All telephone men know that there must be a good ground on grounded circuits for good service. Many ground rods look good, yet have such a great resistance that transmission is poor.

To test for poor grounds, I am using a trouble finder test set, but any kind will do. A trouble finder coil on the test set or a buzzer in series with the generator can be used. A lamp is not good for this test, as it is not accurate enough.

To test ground rods out on the job establish two temporary grounds; hook the test set in series; put the trouble finder coil on one of the test set cords; turn the generator and note the sound in the receiver. If it is good then the temporary grounds are good.

Then connect them together to one side of the test set. Put the other side on the old ground or on the ground that is to be tested and turn generator. If the sound is dim the ground is poor. If loud, the ground is good. With a little practice the resistance can be gauged very closely.

—Contributed by J. W. Herdt, trouble man, Russell (Kans.) Telephone Co.

THERE ARE HAZARDS IN THE CENTRAL OFFICE

Although we do not look for many accidents in our central offices, either being installed or maintained, yet we are having them, says D. S. Adler, Division Safety Supervisor of the New England Tel. & Tel. Co., in "Telephone Topics." A study shows tools to be quite a factor. Now I know that our tools are alright, but it is the way we use them. Perhaps we were not taught the proper use at the start, and perhaps we were. And if we were, we have become so familiar with our job, that we have allowed ourselves to become careless. About as serious an injury as we can meet with is an injury to the eye, caused by the careless snapping of solder from soldering coppers, the slipping of cutters or pliers from wire which is being skinned, or wire protruding from frames or racks. The removal of the cause for snapping solder and wire protruding from frames or racks is obvious. The cutters and pliers slipping can be overcome by assuming the proper working position. Slipping, tripping, stumbling and falling accidents are caused in various ways; miscellaneous pieces of apparatus, tools, and materials are left carelessly on floors; employees walk backwards locating the marking in a frame or rack, electric light cords and wire from reels are allowed to hang across passageways; rushing up and down stairs, halls, through terminal and test rooms with undue haste can readily account for accidents under this heading; objects striking or being struck with, tools or objects dropping from aloft, skinning knives and jack-knives slipping. If the proper position is assumed when these knives in question are being used, no injury will result.

Plenty of Poles

Northern White Cedar Men Meet —No Money for Them in Small Sizes Is Their Plaint

Minneapolis, Minn.—Executives of the leading companies producing and distributing northern white cedar poles and posts met in their annual two day session, at Hotel West, Feb. 5 and 6.

Problems of strictly internal importance occupied a goodly part of the meeting, but the telephone pole buying situation was picked for the most spirited discussion. Particularly were the pole men concerned with the market for the 20 ft. telephone poles. Due to what the pole men state is an unjustifiably low price, caused by over-production of the smaller sizes during the past several years, the margin of profit on the 20 footers has vanished. Relief, from the pole man's view-point, lies in a substantial increase in pole buying by the smaller Independent telephone companies. Producers, in many cases, have reached the point where there will not be so many small poles cut as during the past several years, according to some of those speaking at the meeting.

Clarification of pole specifications and a brisker campaign of merchandising as protection against competitive sources of supply also were discussed during the conclave.

To head the association for the ensuing year, the Northern White Cedar organization elected Elmer Whyte, of Curry and Whyte, Duluth. H. S. Gilkey was named vice-president and Harry F. Partridge re-elected treasurer. Harry K. Bissell and Allen Bole were elected to the directorate.

Additions and extensions to the Bell telephone system in South Carolina during 1924 will amount to more than $565,300.

Tracing Telephone Trouble

Importance of Men Having Proper Mental and Physical Equipment—Test Set Essential; also, Trouble Card Record —Anatomy of the Telephone—Desk Sets vs. Wall Sets

By P. Kerr Higgins

Retardation Coils and Their Use

In operating and maintaining telephone circuits, we find it necessary to use not only high frequency but also low frequency alternating currents; the former for voice currents and the latter for signalling purposes. We also have direct current for supplying the transmitters, relays and other equipment. We have already described the induction coil, which is a type of transformer. We now come to the consideration of the piece of apparatus called a retardation coil. Retardation coils consist of many turns of insulated wire wound around a spool having an iron core and provided with suitable terminals or binding posts. In some cases the coil is protected from injury by an iron shell which also acts as a magnetic shield, preventing the coil from influencing or being influenced by adjacent telephone equipment.

The electrical effect of the retardation coil is almost exactly opposite that of the condenser,* in that the condenser stops the flow of direct current, but the retardation coil only introduces a slight resistance to its passage. Again, the condenser permits alternating current to pass through it and its impedance to the alternating current decreases as the frequency of the alternations increase. On the other hand the retardation coil exhibits a retarding effect to alternating current which increases as the rapidity of the alternations increases and which becomes very high at frequencies similar to those of the voice. This coil, therefore, provides a path for direct current and at the same time introduces high impedance to the flow of alternating current.

The properties of the retardation coil are frequently used in telephone practice. Current supplied by a direct current generator is not always uniform and the variation in its flow may become a cause of noise on other circuits if they are allowed to enter the battery. The use of a retardation coil would tend to prevent these noise producing variations from entering the battery. Retardation coils are wound with single and double windings, the double wound coil being used frequently as a battery feed coil on a branch exchange switchboard where several connections use current from a common battery. In this case the retardation coil permits direct current to pass through the transmitter, but retards or prevents the talking current from passing through the battery.

Retardation coils also frequently serve as the operating coils of relays in common battery systems. This arrangement allows current which flows from the central office battery to the telephone instrument to pass through the relay which controls a local circuit through a lamp. When the lamp goes out due to the operation of the relay it indicates to the operator that the connection has been completed.

Retardation coils are also used on circuits where both telephone and telegraph currents pass simultaneously over the same wire. In an arrangement of this kind, a condenser is placed in series with each telephone instrument and a retardation coil in series with each telegraph instrument. The condenser allows the high frequency current to flow almost unimpeded through the telephone instrument, but cuts off the direct current impulses of the telegraph. On the other hand, the retardation coil prevents the loss of the telephone current due to the shunt path through the telegraph instruments.

Trouble Finder Instead of Trouble Guesser

Just as the medical profession sometimes suffers from unworthy practitioners, so also in telephone practice we have frequently suffered from the quack telephone man. We frequently hear the man who diagnoses and remedies telephone troubles referred to as the trouble man or trouble shooter, but the writer prefers the name "trouble finder" because it has a definite meaning. Alas, we have too many trouble guessers now as always, and the worst of it is that these men are usually past the stage of education. In other words, they are either too lazy, indifferent, ignorant or too old to learn. Seldom will they admit this, but the fact that this class of men **will not study** proves the above assertion to be true. The trained trouble finder, like the trained and experienced physician upon receiving notice that his services are required will usually ask a few well placed questions of the subscriber or patient as the case may be. The information thus obtained will give him some idea as to the nature of the trouble. On the other hand, the untrained or inexperienced trouble guesser, immediately proceeds to the telephone instrument and with a "ten inch screw driver and a large pair of pliers or a monkey wrench" starts to see if he can find the trouble without any intelligent diagnosis of the case. The result is that having opened up several soldered connections, "adjusted" the transmitter, or dismantled the ringer to clear a case of high resistance joint, he leaves the instrument in worse condition than before he arrived.

The writer sometime ago visited the home of Mr. Roberts, the genial general manager of the DeKalb County Telephone Company, Maysville, Mo. During a conversation, Mr. Roberts drew his attention to a telephone on the wall—not a standard make and not one which stands very high in the opinion of most telephone men—and remarked: "That telephone on the wall has been there, I think, for fifteen years and has had no repairs or parts replaced except changing battery and this very seldom." This only goes to show that, as a general rule, telephone instruments are built to give good service without much attention. They are often better off and give better service if inexperienced men can be kept away from them. The same is just as true in regard to almost all other telephone equipment. In his own exchanges, it has been the experience of the writer to find some men, who have been in the business several years, changing a telephone one or more times when as a matter of fact the trouble was a high resistance joint in the line. It is quite common to have telephone men, who should know better, change batteries when a case of "can't hear the subscriber" is reported, when the fact of the case is that the resistance of the line was over 2000 ohms, due to bad connections.

*Editor's note: See article of this series in June, 1923, number for discussion of the condenser and its action.

Test Set an Essential Part of Trouble Finding Equipment

No small exchange is complete without a direct reading voltmeter, which is also arranged that each division represents a definite resistance reading. This voltmeter is usually of the moving coil, dead beat type, carefully constructed with jeweled bearings and thoroughly aged magnets. The pivots are hardened and carefully ground and polished. It is usually of a round type and is arranged for convenient fastening to the switchboard with the extension terminals going all the way through to the back. The most convenient type that the writer has found is the Pignolet type reading from O to three volts, having 250 ohms resistance. The voltmeter scale is divided into one hundred and twenty divisions and half-scale divisions can easily be estimated.

Scale Divisions	Ohms Resistance	Scale Divisions	Ohms Resistance
1	29,750	61	242
2	14,750	62	234
3	9,750	63	226
4	7,250	64	218
5	5,750	65	211
6	4,750	66	204
7	4,035	67	198
8	3,500	68	191
9	3,080	69	185
10	2,750	70	178
11	2,475	71	173
12	2,250	72	167
13	2,055	73	161
14	1,890	74	155
15	1,750	75	150
16	1,625	76	145
17	1,515	77	140
18	1,415	78	134
19	1,330	79	130
20	1,250	80	125
21	1,175	81	120
22	1,115	82	115
23	1,055	83	111
24	1,000	84	106
25	950	85	103
26	900	86	99
27	860	87	95
28	820	88	91
29	785	89	87
30	750	90	83
31	720	91	80
32	685	92	77
33	660	93	73
34	632	94	69
35	607	95	66
36	585	96	63
37	560	97	60
38	540	98	56
39	520	99	53
40	500	100	50
41	480	101	47
42	461	102	44
43	447	103	41
44	431	104	38
45	416	105	36
46	403	106	33
47	388	107	30
48	375	108	28
49	362	109	25
50	350	110	23
51	338	111	20
52	326	112	18
53	316	113	15
54	305	114	13
55	295	115	11
56	285	116	9
57	276	117	7
58	267	118	4
59	259	119	2
60	250	120	0

For specially adjusted voltmeters of other ranges multiply resistances in table as directed below.

Voltmeter range	Resistance of meter	Volts for testing	Multiply resistances in table by
0— 6 volts	500	6	2
0— 12 volts	1,000	12	4
0— 15 volts	1,250	15	5
0— 30 volts	2,500	30	10
0— 60 volts	5,000	60	20
0—120 volts	10,000	120	40

Fig. 1

Fig. 1 shows the resistances corresponding to readings on such a voltmeter when the resistance is connected in series with the voltmeter and 3-volt battery. This voltmeter is extremely convenient, especially for those who have had no technical training and who are thus unable to appreciate or use the more delicate instruments which call for a knowledge of mathematics.

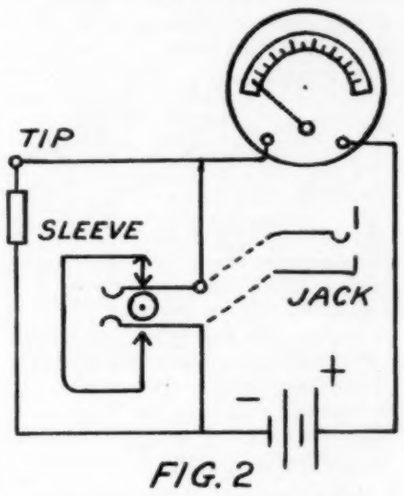


FIG. 2

The manufacturers of this instrument furnish detailed instructions for its operation. In Fig. 2 and Fig. 3 are shown two methods of using this splendid trouble testing instrument. Fig. 2 shows its use for testing metallic circuits, while Fig. 3 shows the arrangement for testing either metallic or grounded by introducing a switch or key into the circuit. The instrument should be connected to a plug and cord on the switchboard, so located that the plug can be inserted for testing purposes into the jack of any line on the switchboard. The instrument should also be connected to a switchboard jack. This is done by bridging the jack onto the cord already connected to the testing circuit as shown in Figs. 2 and 3. This jack is used to test switchboard cords. Any cord on the switchboard can be tested by placing the plug in the test jack, noting the deflection on a good cord and comparing it with the cord or plug under suspicion.

Trouble Card Record a Necessity

In the ideal small telephone exchange a card record would be kept of every subscriber's line, showing in detail the telephone number, name, address, class of service, rate, type and make of telephone, resistance of ringer and number of bars on magneto. The card should also show the amount of cable and open wire in use. By testing out each line with the voltmeter and recording on the card the reading in divisions, and by having a space for record showing date of changing batteries, the trouble man would have very little difficulty in analyzing his trouble. On receiving his trouble ticket he would immediately go to the voltmeter and make a test, noting on the ticket what the trouble seemed to be. For example, if the reading is greater than normal on a metallic circuit, it is reasonable to suppose that the trouble would be either a partial or complete short circuit. If the line is a grounded circuit, a reading greater than normal would indicate leakage or ground in proportion to the reading shown. On the other hand, if the reading were appreciably less than that shown normally, a bad connection or high resistance joint would immediately be suspected. Again, if the reading were normal, it would be reasonable to suppose that the trouble was in the telephone itself.

The experience of the writer and that of many of his assistants has been so satisfactory with a voltmeter of this type that its use cannot be recommended too highly. This is especially true in the average small exchange where the more accurate, delicate and expensive instruments are neither feasible nor practical because of the lack of technical education on the part

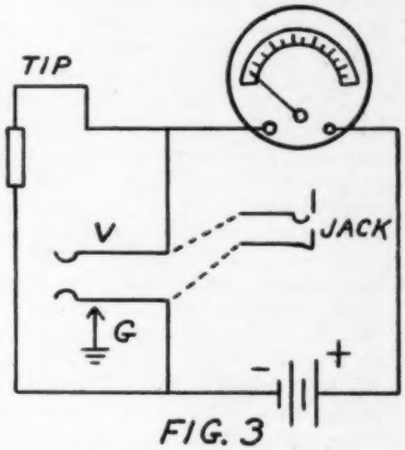


FIG. 3

of the local manager or his trouble man. This instrument is also very efficient in testing coils of every kind, making the location of trouble in them very much easier and more accurate than it could be with any make-shift method. It is also convenient in testing the resistance of transmitters.

A portable type of voltmeter is also made which is very convenient to take

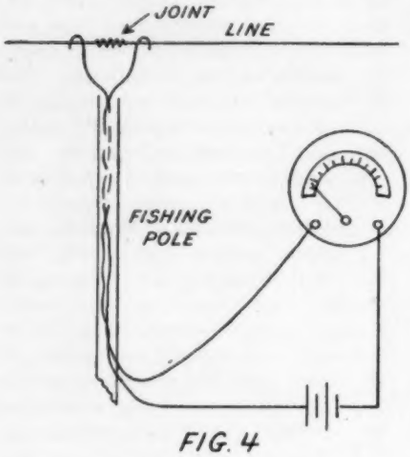


FIG. 4

along when locating high resistance joints on a line. In making this test it is customary to carry the connections up to the line by means of a long fishing pole, one connection being made on each side of the joint under test as shown in Fig. 4. If the current passes through the joint without encountering any appreciable resistance, as shown by a high reading on the voltmeter, the joint is assumed to be good. If a low reading is received joint should be remade or cut out.

Voltmeters may also be arranged for reading current as well as for reading voltage. The current in amperes is read on the voltmeter scale, each division of which equals one-tenth milliampere (.0001 ampere) in instruments of the kind described. If the voltmeter is of a type not calibrated to read directly in ohms the measurement of resistance can be obtained by using Ohm's law, the rule being that resistance in ohms equals volts divided by amperes. The method of doing this is as follows: First, measure the voltage of the battery used; second, note the amperes when the line or resistance is connected in series with the voltmeter and battery. Third, divide the volts by the amperes and subtract the resistance of the voltmeter, which for the type described is usually 250 ohms. The table shown in Fig. 1 was built up on this basis and is given to save the time of the trouble man. If a different voltage than that specified is used, then a new table will have to be made up. Storage battery can be used in the place of dry cells. If dry cells are used, then they should be fresh and of full strength. Measurements of resistance can be made with any type of voltmeter, provided the resistance of the voltmeter is known. The following rule is used: Multiply the resistance of the voltmeter by the deflection given by the current used for the test; divide this by the deflection with the unknown resistance in circuit and subtract the resistance of the voltmeter.

Measuring Resistance of Grounded Line

To measure the resistance of a grounded line connect the voltmeter and battery in series. Connect the negative pole of the cell to ground and the positive pole through the voltmeter to the line under test and note readings on the voltmeter scale. Compare this reading with the table in Fig. 1 if the table applies to the instrument used. If it does not apply use the formula previously given. If the resistance of the line is not steady, due to bad joints or other causes it will be indicated on the voltmeter, the pointer

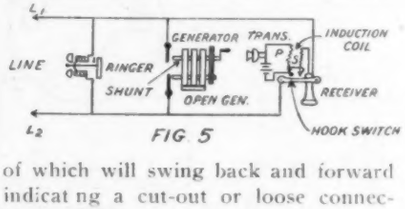


FIG. 5

of which will swing back and forward indicating a cut-out or loose connection. This is also true in testing for a swinging short or ground. It is very important to remember that if we know the voltmeter reading when conditions are normal, then when conditions are off normal the different results obtained will probably reveal at once the nature of the trouble.

The Anatomy of the Telephone

One of the first things taught in medical schools is anatomy or a knowledge of the different parts and organs of the human body. The physician who does not know the anatomy of the human today cannot prescribe intelligently for its ills and is absolutely helpless if a surgical operation is required. In a similar way in telephony the trouble man who does not know the component parts of a telephone and their functions is very seriously handicapped in attempting to clear trouble. In Fig. 1 of the first article of this series, a wall type telephone was shown in detail. The modern telephone or subscriber's sub-set is divided up into the following distinct divisions:

(1) The Signalling Apparatus.
  (a) The Ringer.
  (b) The Magneto.
  (c) Receiver Hook Springs.
(2) The Transmission Apparatus.
  (a) The Receiver.
  (b) Secondary of Induction Coil.
  (c) Receiver Hook Springs.
  (d) The Transmitter.
  (e) Primary of Induction Coil.
  (f) Battery.
  (g) Receiver Hook Springs.

This list comprises the principal parts of an ordinary telephone instrument, to which is sometimes added a condenser in the receiver circuit, the purpose of which has already been explained. The magneto generator may be one of two types—bridging or series. Fig. 5 shows a bridging type in which the generator circuit is normally open. Fig. 6 shows a series in which the generator circuit is normally closed.

In order to familiarize a student with the local circuit of the telephone and also the circuit of the drop in the central office, the following illustrations are reproduced in the hope that they may be of some assistance to him in studying out the functions of the equip-

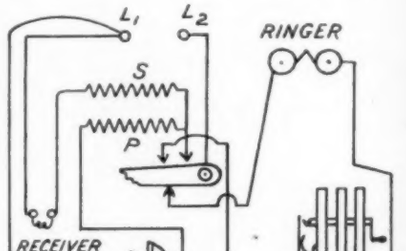


FIG. 6

ment and also the wires composing the circuits. Fig. 7 shows the complete central office circuit of a magneto system. Fig. 8 shows the primary circuit of the telephone instrument with the

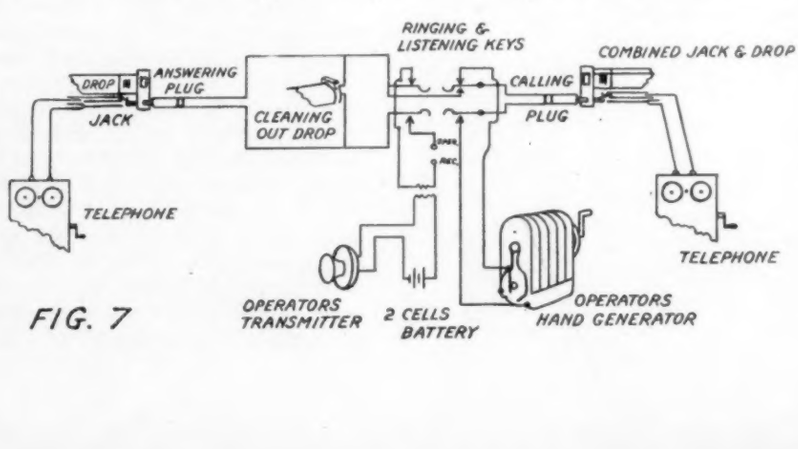


FIG. 7

hook switch contacts closed. Fig. 9 shows the receiver circuit including the secondary of the induction coil. Fig. 10 shows the telephone at the sub-station and a skeleton circuit of the hand

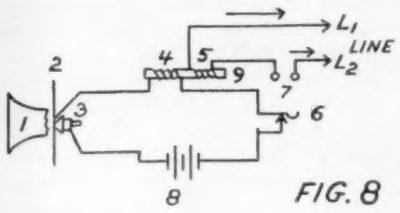


FIG. 8

generator inside the telephone, together with the skeleton of the subscriber's drop at the central office. Fig. 11 shows a series magneto tele-

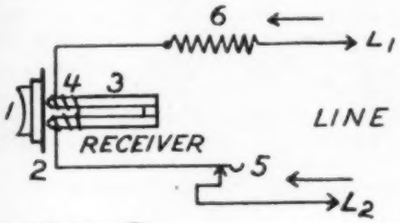


FIG. 9

phone of the desk type and Fig. 12 shows a bridging telephone of the same type. Fig. 13 shows skeleton of a metallic circuit line and also a single or grounded circuit line. Fig. 14 shows the proper and improper way for a subscriber to use the telephone. Only too frequently the improper way is the manner in which the telephone is used. As a result, there is a serious reduction in the volume of transmission. The writer has found that a large proportion of the cases of poor transmission reported are due to the improper use of the telephone. It would be a fine thing if a cut of this kind could be placed prominently in every telephone directory—if possible on the front page. In addition a neat card bearing this cut could in some way be placed on the telephone, under glass, as a constant reminder to the subscriber. In approaching any telephone instrument with a view to finding out the nature of the trouble and applying the remedy, if the complaint has been poor transmission, it is advisable to have the subscriber who usually answers or uses the telephone make a connection and note the manner in which the instrument is used.

If any other trouble than transmission is reported, then the trouble finder should, first of all, seek to decide in his own mind in what part of the telephone the trouble may be located. For example, if the trouble reported is "Subscriber does not hear well," he would scarcely expect to find this in the primary circuit, which affects the outgoing transmission only. It may even be found that the trouble is not in the telephone, but on the outside line. Therefore, the first act of the trouble man should be to short circuit the telephone at the line terminals and note, by putting the receiver to his ear, how the transmitter comes up on short circuit. He can prove his test by taking off the short circuit while the receiver is still held to the ear and note how poorly the transmitter comes up when the line has been brought into circuit. This proves that the telephone is O. K. and the trouble beyond. The short circuit can then be put on the outside at the entrance of the wires to the building, and the same test repeated.

Careful Inspection Important

It has been found to be very profitable to have the trouble man make a thorough inspection of all of the equipment and wiring on the premises every time he goes on a case of trouble. He should see that the ground wire is in first class condition and that all connections are thoroughly soldered. He should examine thoroughly the lightning arrester, and all of the interior parts of the telephone, paying par-

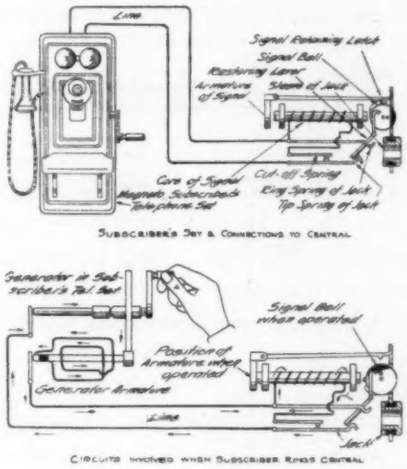


Fig. 10

ticular attention to all connections. All of the spring contact points on the receiver hook switch should be clean and in good condition and the springs should make a positive contact or break the contact cleanly as the case may be. He should also see that the automatic cut-out springs of the generator are operating normally and efficiently under all conditions. Frequently, if the bearings are dry, the generator crank will stick in an abnormal position, producing trouble. A drop of Three-In-One Oil in each of the four generator bearings is very helpful, but one must be very careful not to use too much as it may produce leakage or partial short circuit. He should always be on the lookout for loose generator parts or for a bent spindle or crank as these are a frequent source of serious trouble.

Heavy Repairs Best Made in the Workshop

It is inadvisable to attempt to make extensive repairs at the substation, as one does not usually have the facilities or proper tools for making them. With the modern method of carrying telephones to and from the storeroom by automobile, it would seem to be advisable to change the telephone in case of serious trouble. In dismantling old telephones, the parts can be salvaged and used to good advantage in making repairs on other instruments. No telephone should be taken out of the storeroom without being thoroughly overhauled and in most cases it should be revarnished. Denatured alcohol is found very effective in removing old varnish.

The manager or trouble man who persists in putting in a subscriber's residence or place of business a telephone which has not been thoroughly overhauled and cleaned and if necessary revarnished and the bells renickeled or changed to good ones, is in my opinion unfit to be in the public service.

Much of this rebuilding, remodeling and overhauling can be done by the trouble man on wet and cold days when it is hardly possible for him to work outside. However, it is a difficult matter to get many managers or trouble men to appreciate the importance and value of this indoor work. Usually this type of man prefers to

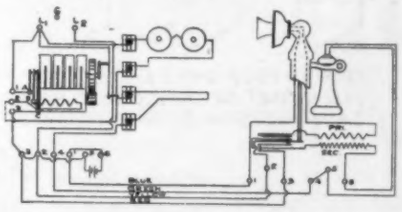


Fig. 11

waste his time elsewhere, which is, of course, of no value to the employee or the employer. Then he wonders why he is not better paid. As a matter of

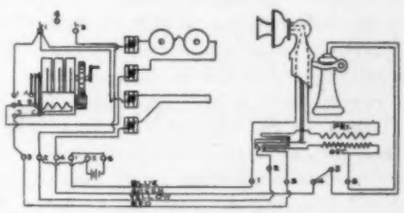


Fig. 12

fact, this type of man is usually not worth what the employer is paying him and the only reason that he is kept on the payroll is the hope that he may, some day, wake up and find himself.

Desk Sets Versus Wall Sets

Telephone companies as a rule do not care to encourage the use of desk sets. Primarily, this is because desk sets are much more expensive to maintain and much more susceptible to injury and breakage than are wall sets. It is customary in many exchanges to make an additional charge for desk instruments. In the opinion of the writer, the subscriber should be held liable for injury and breakage due to carelessness. The following are a few of the many things which are likely to cause trouble to a desk telephone set. If they are carefully studied, one cannot help but appreciate the importance of careful selection in the location of the instrument.

1. Wet hands. 2. Spilled ink. 3. Wet mop lying on cord. 4. Spilled water on cord. 5. Wet cloth lying on cord. 6. Cleaning with wet cloth. 7. Wet sponge. 8. Wet umbrella. 9. Leakage. 10. Wet bouquet. 11. Pin or wire stuck through cord. 12. Fresh paint on cord. 13. Rain through open window.

Tools and the Man

No man can properly take care of trouble unless he has with him constantly his pocket tools and if he has an automobile, the other tools necessary to do the work. He should also carry a supply of extra parts. He should never go on a case of trouble without a test set in good working condition. If he does, it will mean a waste of time and money both for himself and for the company for which he works. In the small exchange the trouble man must be an all-round man. Primarily he should be a first-class lineman with a fair working knowledge of circuits and equipment. He should be a subscriber and regular reader of his trade magazine, and unless he is a finished telephone expert, he should employ a portion of his spare time in studying telephone problems, particularly those which may come up in his own exchange.

Fig. 14

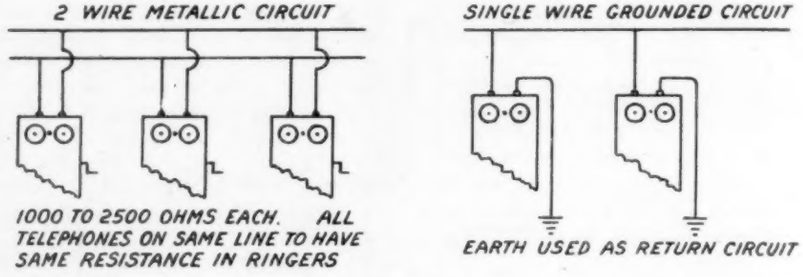

2 WIRE METALLIC CIRCUIT
1000 TO 2500 OHMS EACH. ALL TELEPHONES ON SAME LINE TO HAVE SAME RESISTANCE IN RINGERS
SINGLE WIRE GROUNDED CIRCUIT
EARTH USED AS RETURN CIRCUIT

FIG. 13

BOOK REVIEW

Principles and Practice of Telephony, by Jay G. Mitchell, McGraw Hill Book Co. 5 volumes.

This comprehensive work by a telephone engineer of nationwide reputation will fill a long felt want in the literature of the telephone. Much of the material has already appeared in serial form as a home study course for telephone men but the author has found time in spite of his many duties as Secretary of the Illinois Telephone Association, to make a complete revision of the material, adding much that is new and bringing the work up to date. It is designed for the man who is actually engaged in telephone work but who wishes to acquire or to extend his knowledge of the principles underlying the technical part of the business.

Throughout the five volumes, the author assumes that the reader is familiar with the external appearance of the various forms of telephone equipment and photographic reproductions of equipment parts and assembly have been omitted. The volumes, however, are profusely illustrated with drawings showing details and principles of the various types of apparatus and the circuits in which the apparatus is used. Another deviation from the usual form of telephone books is the classification of equipment based on the principles involved rather than as the systems of particular manufacturers. In fact, manufacturers' names do not appear in the body of the text but their apparatus and circuits may be identified by reference to the index. This arrangement makes possible an orderly and logical presentation of the various topics, progressing from the simpler to the more complex as the knowledge of the student develops.

Vol. I deals with principles and apparatus; Vol. II with circuit elements of line and cord equipment and with power plants. Vol. III is devoted to toll equipment and to the nature and laws of telephone traffic. In Vol. IV, modern high efficiency manual switchboards and the more simple systems of mechanical switching are covered, while Vol. V is devoted to the principles of mechanical switching including semi-mechanical systems and systems designed for large exchanges involving extra heavy traffic. At the end of each chapter a series of review questions gives the student an opportunity to test his knowledge of the material in the chapter and to review the various points before going ahead.

Altogether, this is a work that deserves a place in the hands of every one engaged in any of the technical phases of the telephone business. It should be a part of the equipment of every telephone exchange; as necessary, almost, as the switchboard itself.

Bell of Pennsylvania Plans for 1923

A net increase of 83,500 telephones in Pennsylvania during 1924 is anticipated by the Bell Telephone Co. of Pennsylvania, surpassing any previous record of expansion in the company's history. Such a growth, according to Leonard H. Kinnard, president of the Bell company, will necessitate the addition of 630,000 miles of wire to the 2,500,000 miles already in service in the state, and some 48 building operations, such as new buildings or large additions to present buildings. There are at present 841,600 telephones in the Bell system in Pennsylvania.

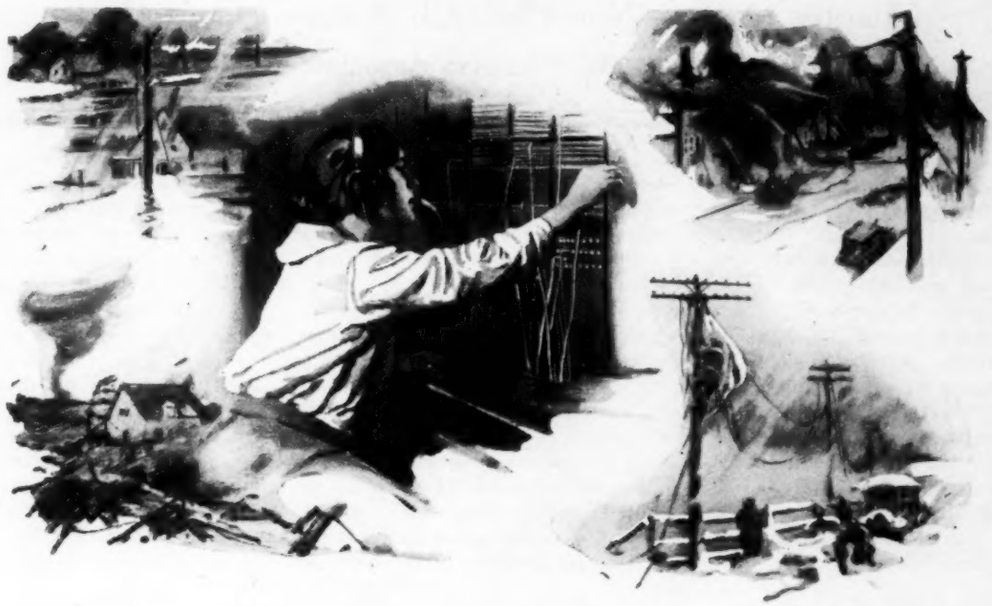
March 6 and 7, Florida's Meeting Dates at St. Petersburg

St. Petersburg, Fla.—Florida's telephone men are inviting their fellow workers in the north to the annual convention of the Florida State Telephone Association, to be held at St. Petersburg, March 6 and 7. The Florida meeting allows an opportunity for a profitable combination of business and pleasure, as the winter season is at its zenith around the time of the telephone sessions. An interesting program is planned, with entertainment features that will present St. Petersburg in its finest and most hospitable aspect.

Kansas Convention at Junction City, March 4-6

The 1924 convention of the Kansas Independent Telephone association will be held at Junction City, March 4-6.

The Oxford Telephone Co., Oxford, Ohio, has been re-incorporated with a capital of $100,000, by J. W. Hutchisson, J. D. Hutchisson, W. C. McSherry, Llewellyn Bonham, G. C. Welliver.



Priceless Service

Despite fire or storm or flood, a telephone operator sticks to her switchboard. A lineman risks life and limb that his wires may continue to vibrate with messages of business or social life. Other telephone employees forego comfort and even sacrifice health that the job may not be slighted.

True, the opportunity for these extremes of service has come to comparatively few; but they indicate the devotion to duty that prevails among the quarter-million telephone workers.

The mass of people called the public has come to take this type of service for granted and to use the telephone in its daily business and in emergencies, seldom realizing what it receives in human devotion to duty and what vast resources are drawn upon to restore service.

It is right that the public should receive this type of telephone service, that it should expect the employment of every practical improvement in the art, and should insist upon progress that keeps ahead of demand. Telephone users realize that dollars can never measure the value of many of their telephone calls. The public wants the service and, if it stops to think, cheerfully pays the moderate cost.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES
BELL SYSTEM
One Policy, One System, Universal Service

Valuation in Rate Making

Chapter XVI. Non-Physical Assets (Continued)

By CHARLES W. MCKAY, Associate Editor*

In the December installment the subject of going value, or cost of establishing the business, was discussed in some detail. It is thought that the presentation of the subject as given in the December and November installments will suffice to give the reader a reasonably good idea of the true significance of the correlation between going value and the value of the purely physical property.

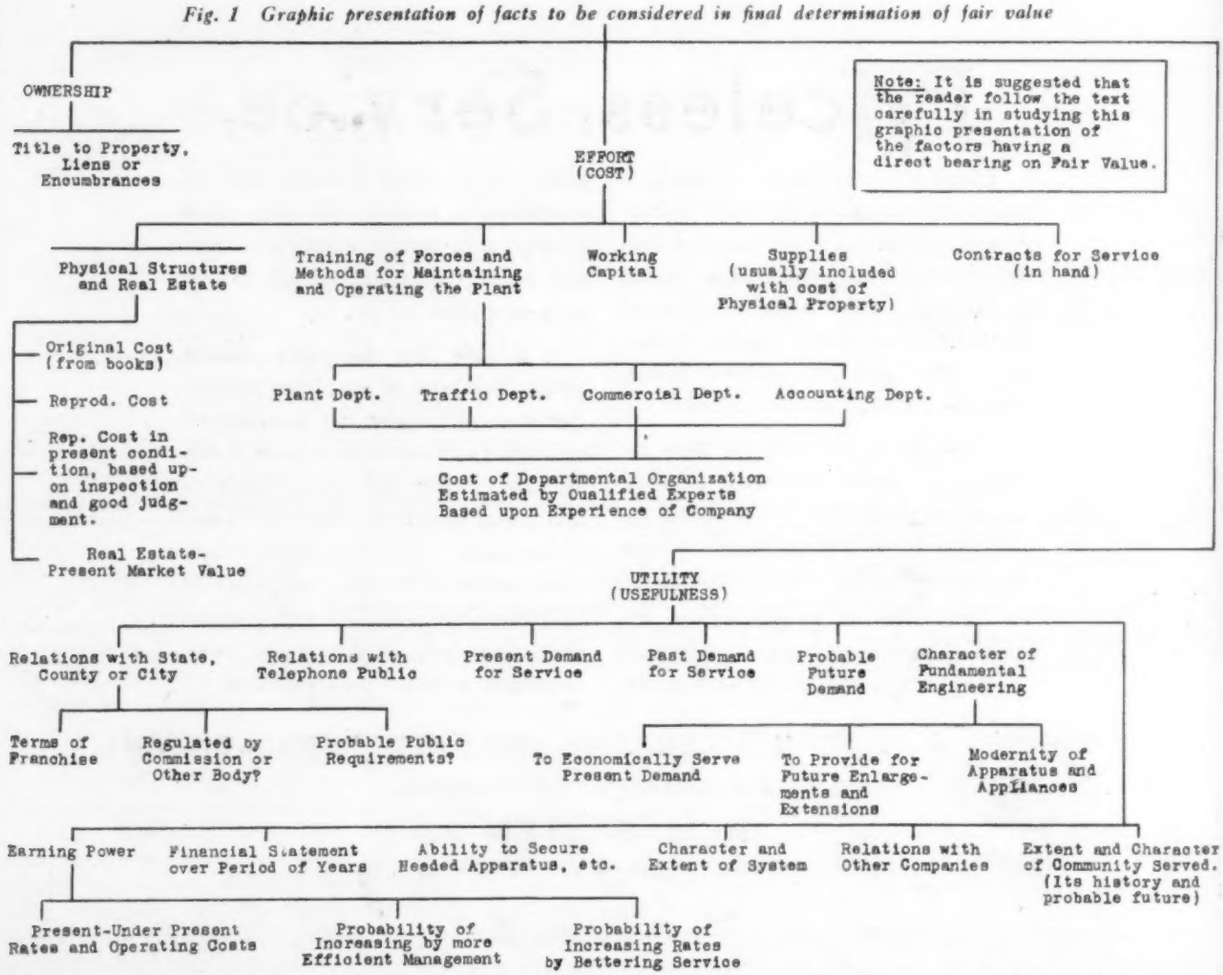
As previously suggested, there are several other items component to the total of the non-physical assets beside cost of establishing business—or going value, as it is often called. These items are cost of franchises, cost of temporary financing and cost of permanent financing—and in the present installment we will accord some consideration to the components of the total of the non-physical assets, aside from going value.

At this juncture, it may be well to direct attention to the fact that, if we are determining value for purposes of rate making, the value of both the physical and non-physical assets must be considered jointly in connection with a number of other factors. Among these factors may be listed the character of service rendered; the standard of maintenance of plant and the financial condition of the company.

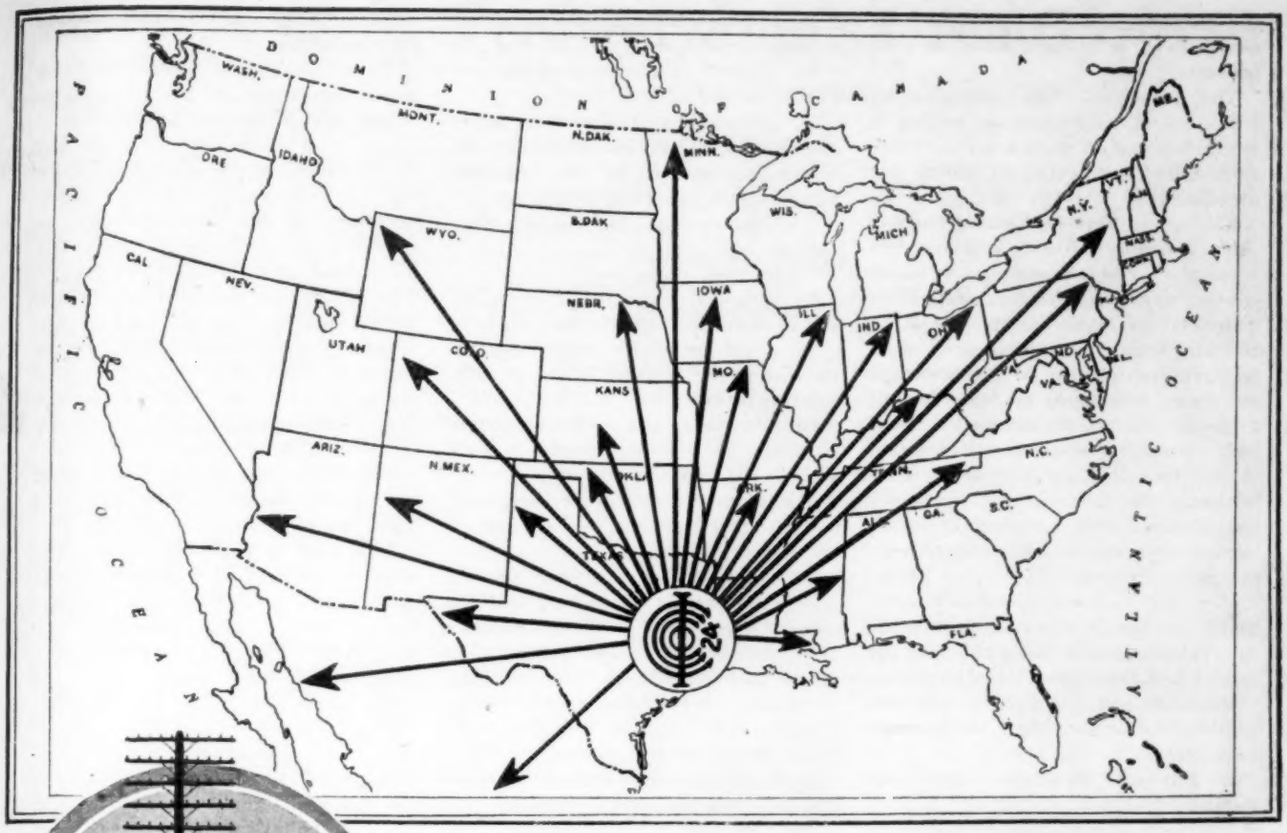
A number of years ago a very interesting exhibit was prepared in connection with a telephone rate case—and this exhibit so clearly presents the various factors to be taken into consideration (aside from the element of value) that it is reproduced herewith in slightly modified form, Fig. 1.

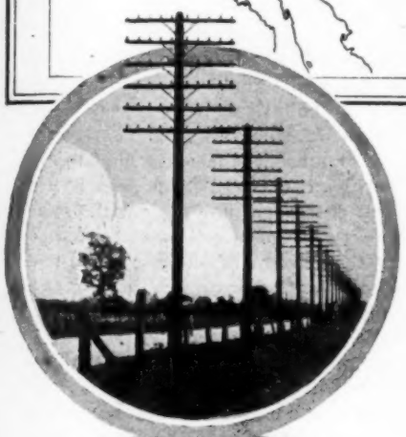
Referring to the paragraph at the bottom of Fig. 1, it will be noted that the exhibit states that "By a consideration of these and such other relevant facts as may exist, a willing buyer and a willing vendor exercising a reasonable judgment, are able to determine what the former would pay the latter, and the latter would accept, for

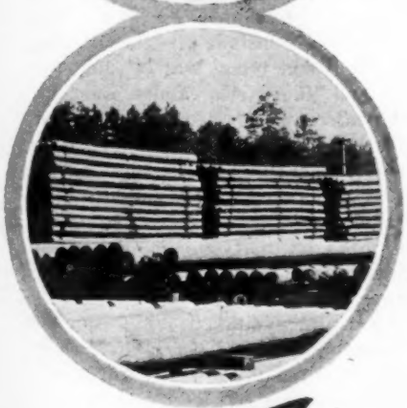
Fig. 1 Graphic presentation of facts to be considered in final determination of fair value


OWNERSHIP
Title to Property, Liens or Encumbrances
EFFORT (COST)
Note: It is suggested that the reader follow the text carefully in studying this graphic presentation of the factors having a direct bearing on Fair Value.
Physical Structures and Real Estate
Training of Forces and Methods for Maintaining and Operating the Plant
Working Capital
Supplies (usually included with cost of Physical Property)
Contracts for Service (in hand)
Original Cost (from books)
Reprod. Cost
Rep. Cost in present condition, based upon inspection and good judgment.
Real Estate-Present Market Value
Plant Dept.
Traffic Dept.
Commercial Dept.
Accounting Dept.
Cost of Departmental Organization Estimated by Qualified Experts Based upon Experience of Company
UTILITY (USEFULNESS)
Relations with State, County or City
Relations with Telephone Public
Present Demand for Service
Past Demand for Service
Probable Future Demand
Character of Fundamental Engineering
Terms of Franchise
Regulated by Commission or Other Body?
Probable Public Requirements?
To Economically Serve Present Demand
To Provide for Future Enlargements and Extensions
Modernity of Apparatus and Appliances
Earning Power
Financial Statement over Period of Years
Ability to Secure Needed Apparatus, etc.
Character and Extent of System
Relations with Other Companies
Extent and Character of Community Served. (Its history and probable future)
Present-Under Present Rates and Operating Costs
Probability of Increasing by more Efficient Management
Probability of Increasing Rates by Bettering Service

By a consideration of the above, and such other relevant facts as may exist, a willing buyer and a willing vendor, exercising reasonable judgment, are able to determine what the former would pay the latter (and the latter accept) for the property in a fair transfer. This establishes the Money Value of the property







International Poles
are in use

East of the Mississippi
West to the Rocky Mountains
North to the States of the Great Lakes
South to the Rio Grande and into Mexico

THERE'S a reason—and a very good one—why International Creosoted Yellow Pine Poles are being shipped into this distant territory. They possess, to a greater degree, every characteristic required for successful pole service — great strength, straightness, durability—and they are available in quantity at reasonable cost.

To give you a means of making an accurate check of the life secured—and to demonstrate the confidence of an old established organization in the quality of its products, International places a copper monogrammed dating nail in every pole, bearing, in actual numbers, the year the pole leaves its plants.

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General Office: Galveston, Texas

Plants: Texarkana, Texas Beaumont, Texas Galveston, Texas

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Creosoted Yellow Pine Poles

the property in a fair transfer. This establishes the money value of the property."

The principal items presented in Fig. 1 (and considered as having a direct bearing on value) are, Ownership, Effort (or cost) and Utility (or usefulness).

Taking up the question of ownership—in connection with any consideration of the subject of value—it is, of course, most important to determine definitely the status of the operating company's title to the property and, furthermore, whether or not there are any liens, mortgages or other incumbrances. As an illustration of what may be considered under the caption "Other Incumbrances," attention is directed to the fact that the subsidiary Bell companies do not own the transmitters or receivers attached to their telephone instruments. The transmitters and receivers, it will be remembered, are the property of the American Telephone and Telegraph Co., the parent Bell Company.

Referring again to Fig. 1, under the caption "Effort, or Cost," we have the following:

1. Physical Structures and Real Estate.
2. The training of operating forces and the development of methods of maintaining and operating the plant.
3. Working capital.
4. Supplies—this item usually being included with the physical structure costs.
5. Contracts for service.

Item No. 1—Physical Structures and Real Estate is subdivided as follows:

(a) Original cost—this being the investment as shown by the books.

(b) Reproduction cost new—as determined by current market prices for materials and labor.

(c) Reproduction cost in present condition—this item representing the net result obtained by deducting the depreciation (as found from actual inspection of the various property components) from the reproduction costs new.

(d) Real estate—its market value at the time of valuation.

The item Real Estate is segregated from the other items of physical property for the reason that its value is usually determined by local real estate experts, rather than by the engineers who prepare the valuation of the telephone property.

The third major subdivision as presented in connection with Fig. 1—utility, or usefulness—is subdivided as follows:

1. Relations with State, County and City.
2. Relations with telephone subscribers.
3. Present demand for telephone service.
4. A study of the demand for service in the past.
5. The estimated probable future demand for telephone service in the community served by the company whose case is under investigation.
6. Character of fundamental engineering.
7. Earning power.
8. Financial statement showing result of operations for the past years.
9. Ability to secure needed apparatus and materials speedily and in sufficient quantities.
10. Character and extent of system of which the property (under investigation) is a constituent part.
11. Relations with other companies for an interchange and extension of service.
12. Extent and character of city where the property is located and the general characteristics of the community served, its past history and probable future (from a telephone standpoint).

Under item 1—Relations with State, County and City—the following sub-items should be considered:

(a) Terms and duration of franchise—giving the right to operate.

(b) Regulation by commission—or some other form of regulatory control.

(c) Probable public requirements.

Under the caption, "Regulation by Commission," it is most important that special attention should be given to the political elements involved. We all know—and some of us to our sorrow—that politics is a controlling factor in the administration of several of the State commissions. When a commission is controlled by a political faction whose slogan is "Down with the Public Utility Rates," the securities of the telephone company suffer accordingly, in that they do not offer an attractive "buy" to the investing public.

Under the subdivision, "Character of Fundamental Engineering," the following sub-items are listed:

(a) The Character of the Fundamental Engineering to economically and efficiently serve the present demand for service.

(b) A careful consideration of whether or not the Fundamental Engineering has been so prosecuted as to provide for economic plant enlargements and extensions—to facilitate the caring for future demands for service.

(c) Modernity of apparatus and appliances. It is most important that switchboards, feeder cable and distribution cable plants, etc., shall be of an up-to-date design—if the company is to render good service to the telephone subscribing public.

It is thought that the other items presented in Fig. 1—under the general caption Utility, or Usefulness—speak for themselves.

To return to the subject directly under consideration—the components of the total of the non-physical assets (other than going value)—let us first consider the cost of financing. In financing a telephone properly it is usually necessary to offer an inducement to capital, over and above the usual rate of interest paid on borrowed money. The reason for this will be obvious. People are not apt to hazard their money in a new undertaking (we use the term, "new undertaking," to comply strictly with the reproduction cost theory) unless the opportunity for gain is more alluring than in other fields which are firmly established and which are equally remunerative insofar as a fixed rate of interest is concerned.

This cost of financing—or "cost of enticing capital," as it might well be called—may be divided into two general classes: Cost of securing preliminary capital and cost of securing permanent capital.

With reference to the cost of securing preliminary capital, it may be said that at the beginning of the construction period the company has little or no tangible property which may be used as collateral for raising funds. The financial backers of the enterprise must be men of sufficient credit to enable them to borrow on short-term notes, until such time as enough of the property has been constructed to warrant the retirement of these notes and the raising of additional capital through the medium of security issues.

To obtain the preliminary capital, it is usually necessary to pay high rates of interest. Some years ago, in a telephone case which was presented before a state commission in a western state, it was found that the prevalent rate on first mortgage bonds was 7% while the rate on short-term notes was 8%. The difference between these two rates (1%) was considered an element of the cost of financing.

Toward the end of the construction period, when the operating company has been brought into being, and endowed with tangible and marketable property, the short-term notes may be retired and additional funds obtained through the sale of permanent securities. Even at this time, however, it is necessary to offer an inducement to obtain capital.

In the first place, to insure the speedy disposal of the permanent securities it is necessary to call upon a reputable firm of financial agents—a banking or brokerage house. This necessitates expenditures for investigations, on the part of the fiscal agents. Obviously, no banker will assume the responsibility of financing property until he is

thoroughly satisfied as to the soundness of the enterprise and as to the integrity of the individuals who are sponsoring it.

Next comes the expense of marketing securities, as well as the profit to the financial agents; and lastly, some inducement in the way of an under-par price must be offered to attract the investing public. As a result, securities which are redeemable at a par value of, let us say, $100.00 a share, often do not net the borrowing company more than $90.00 per share. The difference, $10.00 a share, is a part of the cost of the permanent financing.

From the foregoing it will be seen that the cost of financing is a very real element in the total cost of reproducing a telephone property—and an element that is certainly worthy of most careful consideration, if we are to adhere to the reproduction cost theory.

The attitude of many courts and public utility commissions, on this subject, is evidenced by the following quotation; from the famous case of Hill vs. Antigo Water Company (decision rendered August 30, 1909, by the Wisconsin Railroad Commission).

"The plant in question here, for instance, was built by borrowed money or by the sale of securities which not only bear interest at 6 per cent from the time they were issued, but which also had to be discounted at not less than 9 per cent besides. In other words, they brought 8 per cent less than par value in the money markets.

"If the plant was needed, and these were the best terms upon which the capital for its construction could be obtained, it is certainly difficult to see what other disposition can be made of these charges than to include them in the cost of the plant, at least until they can be written off from earnings, if this course should be found to be advisable, for it is clear that no private parties would enter a business of this kind if they had to foot such losses out of their own pockets.

"Such interests and discounts, therefore, often constitute a part of the price upon which the consumers must pay interest if they desire the conveniences that are offered by the utilities, because these are usually the best terms upon which such utilities can be had. These facts indicate quite clearly that the amount for which interest or discount that it may become necessary to include in the construction account, is a question that depends upon the facts in each particular case, and that it is a matter that cannot always be determined in advance."

The other components to the total of the non-physical assets will be discussed in the March installment of this series.

Pennsylvania's Great Confab

Harrisburg Convention Is Busy and Big

H. E. Bradley, Harrisburg, President.

C. A. Carl, Lancaster, Vice President, Eastern District.

J. H. Wright, Meadville, Vice President, Western District.

Cameron L. Baer, Secretary-Treasurer.

Executive Committee

The president, the vice presidents, W. S. Paca, Oil City, and G. B. Rudy, York.

Harrisburg, Pa.—Territorial limitations were swept away in making the 1924 convention and operators' conference of the Pennsylvania State Telephone and Traffic Association the most successful event in that organization's annals. From all parts of Pennsylvania and from other states as far away as Iowa and Missouri telephone men flocked to take part in a practical, brisk program.

Pennsylvania's debt to the industry, and the achievements of the association during the past year were brought out in the chronicle of the past twelve months which was encompassed in the president address of Mr. Bradley, who was returned to the helm at the annual election.

Again the spotlight was occupied by a consideration of the financial problems of the Independent telephone companies, with President MacKinnon of the national association bringing to the convention a warning against overcapitalization and a summary of the trends in telephone financing, in his address, "The Price of Money." Insurance matters were covered in the paper read by Lynton T. Block of St. Louis whose address reflected the extensive study he has made of the insurance of telephone properties. His insurance recommendations were turned over to a committee for further study and action. From Carl W. Sharer, service engineer of the western division of the association, the convention heard a practical and helpful talk on substation protection.

"The Pennsylvania Situation from the Bell Standpoint" was presented by C. I. Barnard, general manager of the Bell Telephone Company of Pennsylvania. He covered the merger situation with respect to the deals now under consideration. Work of the Pennsylvania Public Service Information Committee was outlined by one of the group's directors, J. S. S. Richardson, who advocated a persistent and intelligent use of newspaper advertising.

The operators' end of the meeting was headlined by Miss Anne Barnes, traveling chief operator of the Iowa Independent Telephone Association, who spoke of "The Telephone Operator—Past, Present and Future." "Classified Toll Calls" a skit presented by five operators showed the relative values of various toll calls. Miss Barnes and Miss Marguerite Norris of LaPorte, Ind., presided over the operators' conference, before which were presented the following talks: "The Patron, the Operator and the Company," by Miss Rosalia Shiber, Johnstown Telephone Co., Johnstown. "Building and Clearing Toll Circuits," by Miss Anna Mazzeo, Mutual Telephone Co., Erie. "How Does the Public Get an Impression of Our Service," by Miss Ethel G. Murray, Traffic Inspector, Jamestown Telephone Co., Jamestown, N. Y. "The Responsibilities of the Operator in the Small Office," by Miss Louaeller G. Hartig, Enterprise Telephone Co., New Holland. "The Art of Satisfying the Public," by Miss Mary Lloyd, Huntington & Clearfield Telephone Co., Clearfield. "What Makes Public Service a Success," by Mrs. Weidensaud, Penn. State Telephone Co., Pottsville. "The Average Operator's Problems," by Miss Florence Wogen, York Telephone & Telegraph Co.

The leading manufacturers in the Independent field were on the job with educational exhibits which contributed greatly to the practical value of the convention.

A theater party at which all attending the convention were guests of the association and the annual banquet and dance were the big entertainment features. Community singing lifted the roof of the banquet hall. Miss Dorothy Paca, daughter of W. S. Paca of Oil City, whose concert appearances in the United States and abroad have been marked with success, provided the artistic bright spot of the banquet's entertainment. John Miller's trick ventriloquist feat was the big laughmaker of the affair.

Wm. J. Ennis, for eleven years manager of the Fond du Lac exchange, has been made district manager of the Madison territory of the Wisconsin Telephone Co., and will look after the 17 exchanges in that district with his headquarters at Madison.

Siloam Springs, Ark.—Extensive improvements by the Siloam Springs Telephone company are planned.

Arkansas Talks Shop

Practical Papers Feature 11th Annual Meeting of State Association

Members of Executive Board

S. A. Lane, Little Rock; Conrad Elskin, Paris, succeeding S. B. Wilson (resigned); Graham McLane, Clarksville; L. M. Emerson, Prescott; F. B. Sprague, Corning.

Arkansas Re-elects

W. M. Graham, Clarendon, president.

J. E. Armstrong, Russellville, first vice-president.

L. D. Evans, Atkins, second vice-president.

George Walker, Sheridan, secretary.

Ernest Sowell, Little Rock, assistant secretary.

Little Rock, Ark.—Hotel Marion here supplied the arena for a spirited battle with the technical and managerial problems of the state's telephone industry, these perplexities being discussed to a standstill by a representative attendance of Arkansas telephone men.

Again financing was in the foreground of state association discussion. The money problems were given treatment from various angles. Walter J. Terry, Little Rock, covered the Arkansas telephone companies' tax problems, suggesting ways and means of keeping taxation within reasonable limits. "Adequate Rates," the subject of D. B. Anderson's address, brought to light practical plans of securing necessary income. "What Constitutes a Profitable Telephone Plant," an illuminating address by George Walker, of Sheridan, and Thomas Stahl's paper on "Financing a Telephone Property," were other high-lights that made the Arkansas program very helpful in its handling of the financial matters that call for managerial attention. The relation of depreciation to earnings was discussed by J. E. Armstrong.

Percy Redmond, general manager of the Southwestern Bell, of St. Louis, gave the assembly an inspiring talk on high-powered salesmanship of telephone service. He presented salesmanship as an art that called for studious development of innate talent, a recognition of certain established tenets of art, and a conclusion that represented a real masterpiece.

An admirable public relation talk was made by L. L. Evans, of Atkins, with the inside slant on public relations being presented to the meeting by L. M. Emerson, in his address on "The Relation Between Employer and Employee," in which Mr. Emerson emphasized that the executives of the company should personify the company as they wanted it represented by their employees to the public.

At the concluding sessions on January 22, Earle W. Hodges, of Little Rock, spoke on "Building and Boosting," and on "Telephone and Utility Progress in Arkansas."

New York Up-State Telephone Convention, May 7-9

J. G. Ihmsen, vice-president and general manager, announces that the annual convention of the New York Up-State Telephone Association will be held at Powers Hotel, Rochester, N. Y., May 7-9, 1924. The date has been set two weeks later than last year in the hope that those attending may use, with comfort, either train, trolley, motorbus or automobile. The prominent manufacturers of telephone equipment, accessories and supplies will display their products. The telephone operators' conference will be held during the entire convention period. Reservations for sleeping accommodations should be made direct with Powers Hotel.

Western Electric's New Supply Office at Minneapolis

The Western Electric Co.'s Supply Department office in Minneapolis, Minn., has been moved to 413-417 South Fourth St. The new location can serve customers better and is much more convenient, among other things, providing a private parking space for cars. The office is equipped with a modern lighting system both for service and for exhibition purposes. An up-to-date display room is provided on the main floor.

Petition for Merger of North Dakota Companies

A petition has been filed with the state commission for the merger of the North Dakota Independent Telephone Co. with the Northwestern Bell Telephone Co. The merger would be accomplished by the latter taking over all assets and obligations of the former company. The Northwestern Bell company, which now owns all the outstanding stock in the Independent company, operates about 86 exchanges under its own name in North Dakota while the latter company operates about 45.

Malad, Idaho.—The Daniels-Malad telephone line has been completed as far as the J. D. Price ranch, according to W. H. Nicholas, one of the promoters. The line will be continued on to Daniels in the spring, seven miles further.

The Southwestern Bell Telephone Co. will make almost a million dollars worth of improvements and extensions at Houston, Tex.

Service Near Normal

Massachusetts Utilities Tests Show Causes of Complaint Being Eliminated

Boston, Mass.—A general improvement of telephone service has taken place in Boston and vicinity, as is shown in a report recently made by William H. O'Brien, chief of the telephone and telegraph division of the Massachusetts Public Utilities Commission. Since the strike of operators last summer, many complaints of poor service have been made and the inspectors of the telephone and telegraph division have been making tests.

In making his report, Mr. O'Brien emphasizes the fact that the great cooperation has been received from the representatives of the telephone company. Among the causes of the complaints that have been made to the commission, were the failure of the operators to repeat numbers to the calling party; failure to mark boards properly resulting in "don't answer" and "line busy" reports; failure of chief operators to report back to complaining parties; plugging on lines where two parties are talking; switchboards too high for operators to reach higher multiples and failure to answer recall flashes. A new system of trunking has been installed which is expected to reduce wrong number complaints and several of the other causes of complaint have been pretty well eliminated.

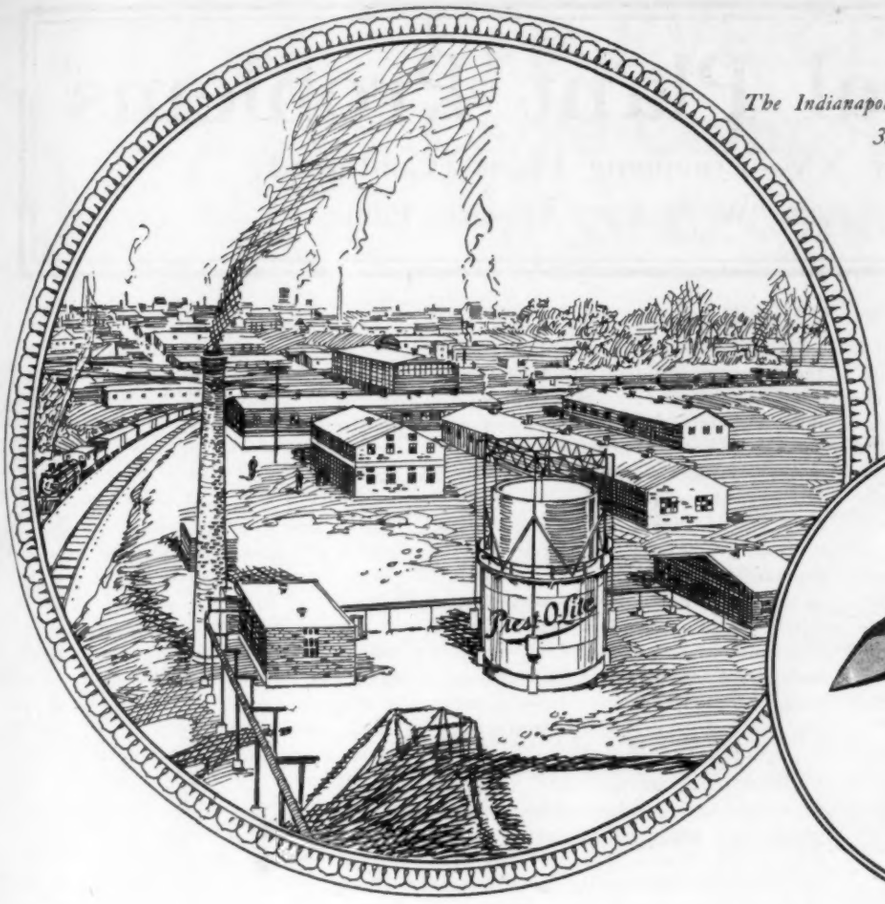
Much complaint was heard over the entire city but it was clear that there was a lot of propaganda against the company by many who sympathized with the striking operators. Nevertheless, a big percentage of complaints were justified by service conditions. The report goes on to point out that all of the mistakes in telephone service are not due to poor operating but many are made by the calling party, by people not using the telephone properly and by people nagging the operator.

A summary of the tests made by the inspectors of the bureau shows 77.8% of the calls answered in less than 5 seconds and over 96% in less than 10 seconds. Operating errors of all kinds were 10%.

Willard Zimmerman Becomes Secretary of Hemingray Glass Co.

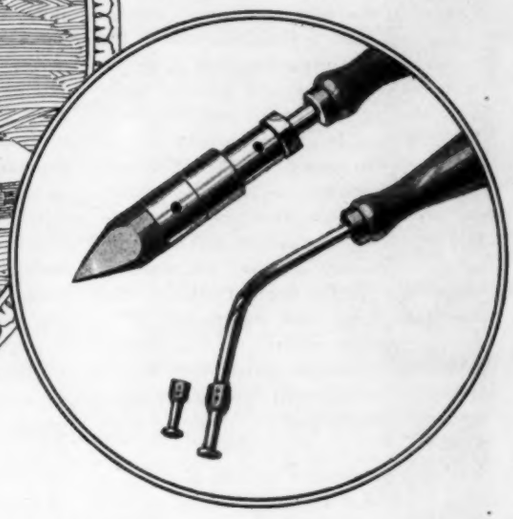
Hemingray Glass Co., Muncie, Ind., announces the following changes in its organization:

W. Edgar Evans, while retaining his interest in the company, retires as secretary and director to devote himself to personal affairs; Willard P. Zimmerman succeeds Mr. Evans as secretary.



The Indianapolis Charging Plant—One of the 35 Acetylene Plants

The Sign of Universal Gas Service



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This outfit is light—easily available for the job, whether it be outdoors, up a pole or down a manhole, or for inside work at switchboards and the like.

This outfit burns Prest-O-Lite Gas from a small, easily carried tank; there are two types of torch heads and a soldering iron in the outfit. A small head giving a flame about 3 inches long—for lighter soldering and brazing operations; a large head giving a 6-inch flame for heavier brazing and heating jobs; a 2-lb. soldering iron that heats up quickly and holds its heat no matter how much you use it—properly balanced.

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The Gas of a Thousand Uses

Practical Plant Problems

Chapter XV—Financing Plans (Continued)

By Charles W. McKay, Associate Editor

In the December issue of this series of articles we discussed, in a general way, the subject of "Financing Plans." The writer was certainly gratified to note that the aforementioned articles stirred up quite a little interest in the Independent telephone field. M. L. Golladay, secretary and general manager of The Holden Home Telephone Co., Holden, Mo., a man who is unusually well versed in executive and managerial problems—took the trouble to comment at length upon the article. Mr. Holden's comments are so interesting that they will be discussed in some detail in the present article. Before taking up this discussion, however, it may be well to review, briefly, the subject matter presented in the December installment—especially insofar as it relates to Mr. Golladay's comments.

In the December article, the writer suggested that the problem of obtaining funds for plant rehabilitation, and for plant extensions, is an exceedingly difficult one, when viewed from the standpoint of the Independent telephone companies. It was further suggested that many of the larger companies enjoyed cordial relations with various subsidiaries of the American Telephone and Telegraph Co., and through this medium were able to obtain the needed assistance in solving their respective financial problems. It also was suggested that many of the smaller companies, through the aid of strong state associations, received a good deal of help with respect to matters pertinent to their refinancing problems. However, hundreds of small Independent companies are not fortunate enough to receive tangible help from their respective state associations, and are not in close enough contact with the American Telephone and Telegraph Co. to receive aid from that source. It is these latter companies —the small, more or less isolated, Independent companies—that the writer had in mind especially when he prepared his article for the December issue. It was suggested therein that a definite program be adopted and that this program take somewhat the following form:

First: Have a thorough and careful valuation made of all of the physical property—with a view to determining the inherent, residual values; the values of the portions of the plant which may be retained in active service and the values of the portions of the plant which should be "junked" to make way for needed replacements.

Second: Have a careful engineering estimate prepared. This estimate should be made from a commercial standpoint to determine new business possibilities, and also from the plant standpoint to ascertain the replacements, betterments, and extensions which are necessary to provide good telephone service, and put the company's business on a paying basis.

Third: All of the data resultant from the studies suggested in the foregoing two paragraphs, should be incorporated into one report—so prepared that it may be readily analyzed and may serve as a basis for the preparation of a financial report (for bankers), or for use in direct stock or bond selling campaigns. The foregoing report should be accompanied by a statement of plant assets, and a statement showing the method of deriving the funds necessary to consummate the new financing.

The statement just referred to should show the various property accounts; the corresponding depreciated values (as obtained through the medium of a plant valuation); the amounts necessary for plant rehabilitation and plant extensions (properly classified by accounts), and the total assets, as they will show on the books after the new construction work has been completed. This statement also should show the derivation of funds. Part of the funds doubtless will be obtained from the sale of bonds, while the balance will be obtained through the sale of stock—probably preferred stock.

In this connection, it may be said that it usually is a good plan to provide for plant betterments and extensions through the medium of the funds obtained from the sale of bonds. The bond issue, however, should not exceed from 30 to 50 per cent of the depreciated value of the physical property—as found through a carefully prepared plant valuation.

In the December article, the writer also referred to the plan of selling securities locally. This plan was originated by Samuel Insull, one of the greatest public utility-executive-financiers in the world. There are several reasons why this plan is especially successful. If securities are disposed of locally, nearly every buyer, quite naturally, will be a subscriber to the telephone service and every buyer will be a "booster" for the company. This is an inevitable result of a local-security-selling campaign. The reason is obvious: People who have money invested in a company are not disposed to be unreasonable about rates, that are adequate to produce a fair return upon investment.

Returning to Mr. Golladay's comments upon the discussion of the financial problem as presented in the December issue. In the article above referred to the writer made the following statement: "In the past, however, the larger Independent companies have found ways and means—especially with the assistance of the Bell interests—for obtaining needed funds, but the 'little fellow' has had a well nigh, hopeless task, unless he has been fortunate enough to have a 'good angel' back of him—the 'good angel' being the local banker or some manufacturer or business man, rich and powerful enough to come to the rescue at the psychological moment."

Mr. Golladay rather took exception to this statement in his first letter—but in his second letter, it would seem that Mr. Golladay's ideas and the writer's coincide rather closely. Quoting Mr. Golladay's first letter:—

"Mr. McKay's article on Financing Plans, saying that 'The little fellow has a well-nigh hopeless task' is so at variance with our experience, that I cannot help but write you our recent experience.

"This company now in its twenty-third year decided last week that we would overhaul our outside distribution in one of our exchanges, at an outlay of several thousand dollars.

"The directors met one evening and decided to finance one-half out of depreciation reserves, the other half by selling additional stock. It was de-

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COVER WITH 3" DIRT UNTIL COOL
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FINISH

cided that, in view of the fact that the commission will not allow stock dividends, the stockholders would be given the benefit by allowing them to subscribe for this issue at par. Before ten o'clock the next morning, telephone orders were received for more than double the needed amount, and when the letters announcing the offer went to the stockholders, we could have placed ten times the amount. This all inside the stockholders, without letting the public have a chance at it.

"Six years ago, we bought a neighboring exchange, issuing capital stock to finance the purchase. This issue was sold at 25 per cent premium, without a penny of sales expense.

"Our bookkeeping is in strict accord with the I. C. C. system of accounts and our rates are low, viz., bus., $2.00; res., $1.25—for common battery, individual line service; 1500 telephones.

"We pay 4 per cent semi-annual dividends in cash. Where is the discrepancy? There must be something wrong with a telephone company that cannot get money to finance its needs right at home."

The editor replied to this letter and in response, Mr. Golladay wrote further as follows:

"Regarding the troubles of the small telephone company, have to say that the writer's observation is about as follows:

"For some reason, or no reason, the butcher and baker and candlestick maker decide to embark in what to them appears to be a business that must be practically all profit.

"They organize by each putting in a hundred dollars, or less; an article in the local blatter announces the organization; this brings a flock of apparatus peddlers to town; the directors, who by this time have swelled up with their importance until Grant's overcoat wouldn't make them a vest, meet in the 'parlor' of the local hostelry to hear each peddler sing his siren song; after much labor and travail, the switchboard and telephones are purchased, generally of the salesman who is the 'best fellow.' The friend or relative of some stockholder is hired to set the poles, string the wire and install the telephones; the peddler returns, 'hooks up the switchboard' in an upstairs back room over the corner grocery; a gum-chewing, irresponsible flapper is employed as 'Central' and the stockholders sit down to await the flow of shekeles, which are supposed to roll like shelled corn out of a corn sheller.:

"The switchboard having been purchased and the outside plant built for immediate needs, without any thought or survey of the future growth which is bound to come, in a few years we find the following condition:

"The central office equipment has been 'maintained' by the combined manager, troubleman, collector and lineman, using a pair of eight-inch pliers and a pair of 'hooks,' until it is ready for the junk heap; the outside construction looks more like 'destruction,' and is in even worse condition; circuits for which no provision were made are hung under the arms, or knobbed up and down both sides of the poles; the guying which originally was principally attached to the 'natural scenery' has given way and the 'king pole' at the central office looks like a Chinese prescription for the chills. Additional apparatus and material have been purchased out of gross receipts and money borrowed from the local banker (on which the interest is past due); the service is rotten; the bookkeeping consists of the bank book (liberally decorated in red), a receipt book carried in the lineman's overalls, a hook made out of No. 12 hanging on the back of the switchboard and decorated with dust-covered invoices; and a spindle with the unpaid toll tickets ornamenting the top.

"Growth having been financed out of receipts, of course no dividends have been declared or paid. Lack of properly kept books precludes the possibility of any real knowledge of the true condition of the company. The lineman who has been blamed for the lack of service, passes the buck and says, 'Our old switchboard is worn out.' The stockholders who have their own business to look out for have long ceased to have any interest in the affairs of the company; they have lost customers because some old woman got a 'sassy' answer from Central, etc., and they have decided in their own minds that if a new switchboard is bad, some one else will have to raise the wind.

"This is the 'little fellow' that Mr. McKay must have had in mind, to whom 'financing was well-nigh an impossibility.'

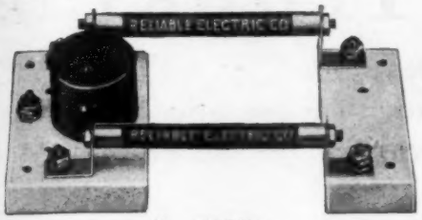
"On the other hand, the writer has witnessed a telephone company, organized in 1900 with three stockholders who subscribed $2,100.00, grow until in the year of our Lord 1923, the following is the picture:

"A system of four exchanges, connected with metallic toll lines; with farm lines covering every inch of its territory of twenty miles square; operating fifteen hundred telephones, and owning its own business buildings; its principal commercial office modernly equipped with bookkeeping machines; vault and office furniture comparing favorably with any bank in town; with $50,000.00 capital stock paid up, and $75,000.00 worth of physical property (counting nothing for franchises or intangibles) as allowed by the Public Service Commission for rate-making purposes; the principal exchange full common battery including farm lines —and has been common battery for fiteen years; no preferred stock, bonds, mortgages or other indebtedness of any kind; looked up to as one of the most substantial businesses in the community; its stockholders the most influential people in the territory served, and men who consider it a favor to be selected to participate in the earnings and activities of the company. All this accomplished at the magnificent rate of one and two dollars. This is the 'little fellow' I had in mind, to whom financing is the easiest thing he does.

"To sum it up, as Franklin said: 'Keep thy shop and it will keep thee.'

"Usually, the troubles of the 'little fellow' are not the fault of the business, which the writer believes to be the best business in the world, but his lack of realization of the fact that the Telephone Business is a **real** business, to which business principles will apply, the same as in any other business."

In the last analysis, it will be seen that Mr. Golladay and the writer have essentially the same thoughts in mind. In other words, small Independent companies that are carefully managed —managed in such a way that the executives keep in close touch with the directors and stockholders and customers—have little or no difficulty in raising the funds needed for plant extensions and betterments. On the other hand, companies organized many years ago by men with little or no present interest in the affairs of the company, find themselves constantly confronted with an exceedingly difficult problem. As Mr. Golladay suggests, growth has probably been financed out of earnings; few if any dividends have been paid, and little or no attention has been paid to the accrual of an adequate reserve for depreciation. Consequently, when the plant is in need of rehabilitation, it is pretty hard to find people who are willing to put up the necessary capital. The residual value of the property is apt to be low —due to lack of proper maintenance— and the rates usually are inadequate to pay a fair return upon the investment. Quite naturally, a proposition of this nature is not enticing to investors. It is companies whose affairs have reached such crises, that we had in mind, especially, when making the suggestions incorporated in this and the December articles. They, of a necessity, must tackle the refinancing problem in a thorough-going, business-like manner.



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Locating Moisture in Cable

Expert Gives Practical Methods

By CHRIS D. STEWART

The most troublesome of all faults in cable is caused by moisture, which is sometimes very difficult to locate. There are four methods in use at this time for the location of such faults. First, the Wheatstone bridge; second, the "wireless" or exploring coil method; third, cut and test; and fourth, just go out and look for a defect in the armor or place where the moisture entered the cable.

The most trouble of this nature is located by the second method, as it is the most practical in a majority of cases. The writer expects some engineers to take issue with him in regard to this statement, especially those schooled in the use of the bridge.

The Wheatstone bridge method is rather complicated and, in a great many cases, the parties making the tests have not had the advantage of a technical education to the extent that they are familiar with the use of such instruments. To remedy this condition, Stewart Brothers of Ottawa, Ill., have made exhaustive tests of methods and instruments which any telephone man can use for location of such trouble.

When water enters a cable, it is of very high resistance. But as the current continues to flow through it, its resistance decreases. This is, no doubt, due to chemical action caused by the current flow through the water connection between the copper wire and lead armor.

One of the reasons for the failure of the exploring coil method of location of water trouble in some cases is the fact that the resistance of the water between the wire and lead armor increased to a point where a test could not be made as soon as the battery was taken off the cable wire.

In the latest Stewart test, the battery is not taken off the wire. The cable tester is connected to the wire under test and the jumper at the rack left on, so that current will flow out over the wire to the trouble and keep the resistance down as explained above. Of course the cable tester must be so arranged that it will not short circuit the current from the line. The Stewart cable tester is so arranged. In cases where the relay or battery feed is not of high enough impedance to keep the current from the cable tester out of the battery, one side of a repeating coil can be connected in series with the jumper wire on the battery side of the line. In other cases where there would be some objection to leaving the line connected, a battery tap can be connected through the winding of a repeating coil or other impedance coil. A bridging drop coil

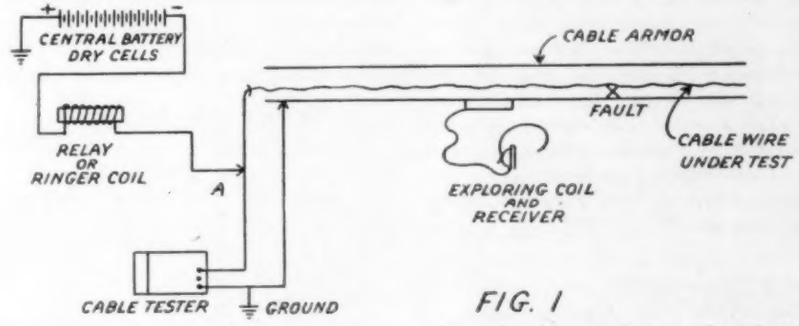

FIG. 1

(Continued on page 44)

Straightforward Trunking

Description of New Method of Trunking Developed by A. T. & T. Engineers as Used in New England Territory—First and Second Stage Operation Is Detailed—Equipment Required in Second Stage

By SIDNEY I. DANIELS

(Trunk Traffic Engineer, Metropolitan Division, New England T. & T. Co.)

Courtesy of Telephone Topics

It has been said that there is "nothing new under the sun." Whoever said that was not a telephone man. In the telephone business there is always something new. This time it is "Straightforward Trunking."

The average telephone employee, as well as the average telephone user, gives very little thought to the development of the telephone industry. Occasionally, we hear of the Development and Research group of the American Co., or the "D. & R." men, as they are called. The "D. & R." men catch the young ideas and develop them into full-grown circuits or methods, and sometimes into new types of offices. The idea of Straightforward Trunking originated a good many years ago, and has been under consideration by the "D. & R." men for a long time. Experiments along this line were made here in Boston about three and one-half years ago, when an attempt was made to eliminate the call circuits into Tandem. It was arranged at that time to have the "A" operators in certain offices pass their calls by plugging in on idle Tandem trunks to get the Tandem operator; when the Tandem operator answered the "A" operator gave the number desired. The Tandem operator in turn passed the number to the "B" operator at the terminating office. This was called the "plug-in method." It was used with considerable success for several months, but as new and undeveloped circuits and equipment were required, it was discontinued after a thorough trial and the results of the experiment sent to New York, eventually reaching the "D. & R." group.

The new method was finally installed and tried out on the Tandem board in Philadelphia under the new name of "Straightforward Trunking."

"Straightforward Trunking" is just what the name implies. Trunked calls are handled in a manner that is straight forward from one operator to another operator somewhat similarly to our Ring-down method.

There are several stages of development to "Straightforward Trunking." At present there are two stages in use in the New England territory, the "first" and "second" stages. The "third" stage is but little different from the "second" stage, and will not be described at this time. It need only be mentioned that a trial installation of the "third" stage is to be made in Boston at a later date.

The "first" stage now in use at Boston Tandem is comparatively simple, the only equipment necessary at the "B" position is a multiple jack cross-connected through special apparatus to the "B" operator's telephone circuit.

At the "A" end no special apparatus is needed. The only work at the "A" end is to place designation strips that are distinctive and to place "preferential" markings on the trunk multiple jacks. These serve for the "first" and "second" stages. A designation strip and a jack strip with a preferential marking are illustrated in Fig. 1. The office name is made large and distinct and the assignment numbers small. Under this method of operation, the office name is the most important, the assignment numbers being used only for reporting trouble and late at night.

Markings Must Be Correct

Smooth operation of "Straightforward Trunking" depends to a great extent upon the preferential markings and their correct use by the "A" operators. It is essential that the load be spread out evenly over the trunk groups; that the testing by "A" operators be reduced to a minimum and that the preferential jacks be within easy reach. A preferential jack in each Straightforward trunk group is assigned to each "A" position and designated by outlining the jack with a square of orange or red paint. This jack is the jack with which that particular operator starts testing.

The operation of "Straightforward Trunking" is comparatively simple and is certainly much easier for the "B" operator, as there are no transmission difficulties to contend with, there is no interference or "breaking over" on the call circuit, and there are no assignment numbers to keep in mind. A brief description of the operation of the "first" and "second" stages follows:

First Stage

When an "A" operator wishes to pass a call to a point reached by either stage of the "Straightforward" method, she selects an idle trunk to the desired office by testing the trunk group, starting with her preferential jack and continuing to the right until an idle trunk is found. If all are busy to the right of the preferential jack, she tests to the left, starting with the preferential jack. On finding an idle trunk, the "A" operator plugs in with her listening key open, lighting the trunk guard lamp in front of the "B" operator. When the "B" operator is connected to the trunk, the "A" operator receives a series of clicks or a momentary tone in her receiver. Upon receiving the signal that the "B" operator is on the trunk, the "A" operator passes the number to the "B" operator as usual. The "B" operator responds with "Right" if she understands the order. If the "B" operator does not understand the order, she says "What number?"

The "B" operator under the "first" stage operation must watch her guard lamps. When a guard lamp on a trunk lights, she picks up the cord and inserts the plug into her listening jack. This gives the "A" operator a series

Fig. 1. Designation strip and jack strip with a preferential marking

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The first splicing clamps were made by Klein—they are still the best!

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defines a structure of porcelain that is hard, well fired, impervious to moisture and provides unparalleled strength mechanically. For well over a quarter century we have concentrated an expert force of engineering talent and exceptional plant facilities on the production of Insulators of the "superior" kind.

One branch of our business has been to maintain ample stocks of modern telephone insulators ready for the immediate call of the trade. Prompt shipments can be assured at all times, whether your requirements call for barrel or carload lots.

Your name entered on our mailing list will insure your receiving valuable literature as issued.

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of clicks or a momentary tone. Upon receiving the order from the "A" operator, she responds with "Right," removes the plug from the listening jack, and proceeds to put up the connection in the usual manner. Upon the completion of the connection, the "B" operator proceeds with the next call that

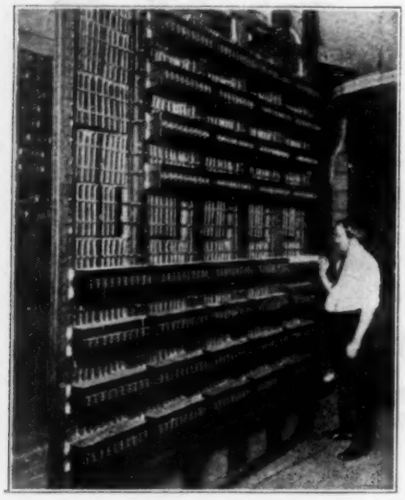


Fig. 2. Showing second stage equipment

is waiting, as indicated by the guard lamps.

Many "B" operators acquire considerable dexterity in handling these calls by the "overlap" method, making connections in the multiple with one hand while plugging a trunk into the listening jack with the other. Team work is also possible, as the "B" operators can assist their neighbors on either side.

Second Stage

The "Second Stage" is in use in BACk Bay, BEAch, CONgress, HAYmarket, KENmore, MAIn, and RIChmond in the Metropolitan Division and in all of the offices in Providence. The operation is faster than the "first" stage and requires a large amount of equipment work (Fig. 2).

The outstanding feature of the "second" stage is the automatic connection of the incoming trunk to the "B" operators' telephone circuit.

Let us follow a call through from a MAIn "A" operator to a BEAch "B" operator on trunk Number 9 (Fig. 3). The MAIn operator selects an idle trunk, using her preferential jack as a starting point, and tests over the group until she finds an idle trunk. She plugs into the idle trunk; instantly several things happen. First, a chain of relays on the BEAch "B" position is operated. Second, if the BEAch "B" operator is not receiving a call over any trunk at that instant, the guard lamp of trunk Number 9, into which the MAIn "A" operator is plugged, starts to flash on the BEAch "B" position at the rate of 120 times a minute (Fig. 3). Third, a momentary tone is sent out over the trunk telling the "A" operator that the "B" operator is connected to her trunk, and simultaneously the "B" operator's telephone set is connected to the trunk. Upon receiving the tone, the "A" operator passes the call to the "B" operator, who in turn repeats "Right" and puts up the connection. The instant the connection is put up, the guard on trunk Number 9 stops flashing and goes out, and the guard of trunk Number 12, which has been burning steadily, starts flashing and another "A" operator at MAIn, who has been waiting her turn, is connected to the BEAch "B" operator's telephone set. Meanwhile, the guards on trunks, Numbers 17, 24 and 3 have lighted. These will be connected in rotation, the trunks being selected from left to right. If the MAIn "A" operator had selected trunk 3 instead of trunk 9, the guard lamp of her trunk would have burned with a steady light until trunks 9, 12, 17 and 24 had been answered and connected.

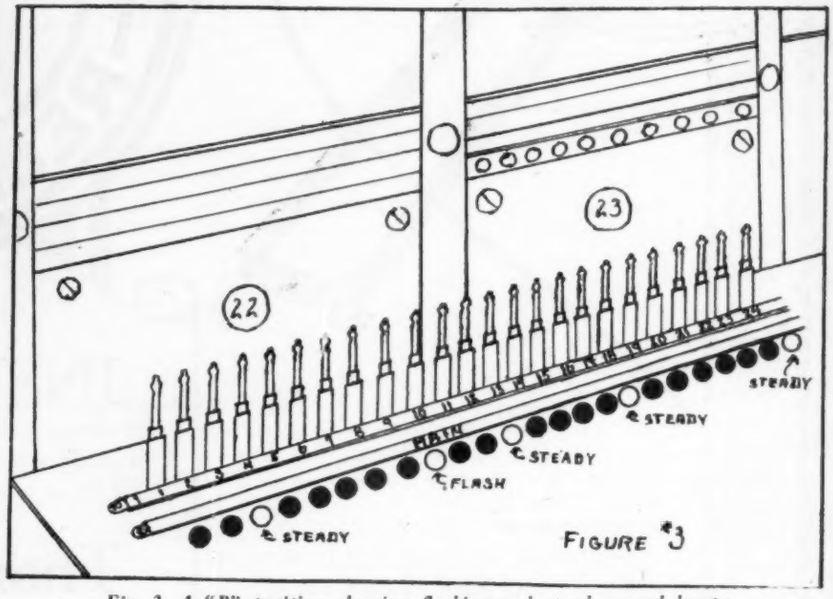


Fig. 3. A "B" position showing flashing and steady guard lamps

PROTECTION

Central Office and Substation Protection Features Are Outlined by Expert

Minneapolis, Minn.—Central office and substation protection, a subject always good for convention material, received expert handling by George R. Folds, president of the Cook Electric Co., Chicago, who spoke on this phase of telephone work before the Minnesota Telephone Association convention. Mr. Folds stressed the ever-growing importance of telephone system protection in connection with the increase of power lines. He said:

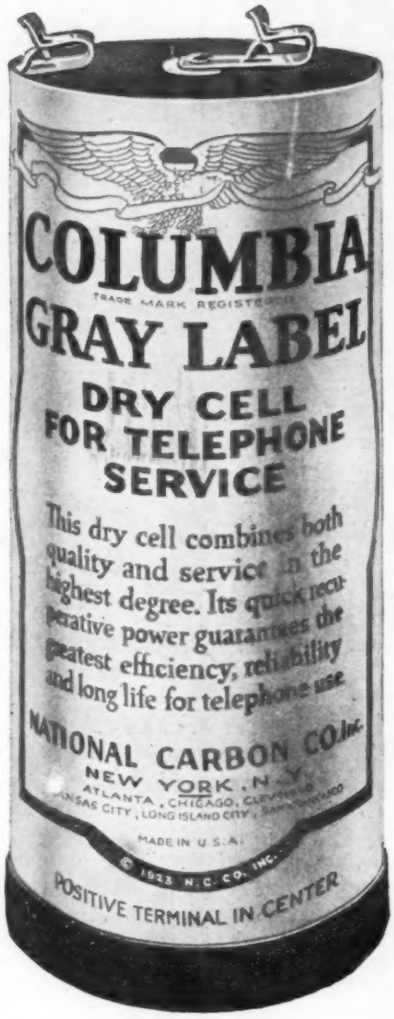
"Nearly all telephone men and their subscribers are afraid of lightning and are apt to think of lightning hazards as the great hazard requiring protection in the telephone circuit.

"The fear of the subscriber is, of course, one serious reason why the telephone company should protect its apparatus at the substation, but the hazard from power wires is the one which the telephone man should most seriously consider on account of possible danger to his property.

"The late Charles P. Steinmetz carried on the most extensive experiments known in the study of lightning, and it was his judgment that of all the lightning seen in the sky during a severe storm, less than 5 per cent reached the earth through direct stroke.

"The discharges seen in the heavens are nearly all in the air and not between the air and the earth. When we have a direct stroke, there is no protecting apparatus made able to stand it. The damage which may occur in telephone apparatus during an electrical storm is practically all due to induced currents which often are quite dangerous.

"The remark is sometimes made that there has been very little improvement in the development of lightning protectors, and it is true that a simple cut-out or air gap has been and still is the method used for lightning protection. Manufacturers and others who have made a close study of this subject have found that great improvement can be made in the manufacture and design of lightning dischargers, and the cost of their maintenance can be best con-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trolled where the air gap is accurately made and maintained.

"It has also been found to be important to use open space cut-outs with different air gaps in different places, depending on the service they are expected to meet. In the country where the telephone man has no power lines and only lightning to protect against, he can safely use air gaps of wider dimensions than where he must also provide a path to ground for a high potential power circuit. For lightning alone, an air gap of a ten-thousandth inch or even more might be safely maintained, but if a power circuit of 500 or 600 volts is to be considered, the air gap should be approximately three-thousandth inch.

"Experience has shown that the cut-out of the saw-tooth type cannot be manufactured in quantities with sufficient accuracy, and therefore where this type of discharger is used, there frequently is no protection at all. It has also been found, where it is necessary to reduce the air gap to small dimensions, that it is difficult to keep the air gap free of dust. In the selection of a discharger, therefore, we should be careful to choose one of the right air-gap dimensions and of the proper type of construction to be free from dust trouble.

"The lightning dischargers which have been furnished as a part of telephone equipment are not approved by the underwriters and are not safe to rely upon. In the discussion of substation protection at the recent national convention, W. S. Boyd, secretary, Western Association of Electrical Inspectors, called attention to the fact that protection dischargers built in the telephone had not been found valuable from a protective standpoint. Information of this discussion can be obtained from the United States Independent Telephone Association. As manufacturers, we are always ready to give advice as to what we believe should be used, but our experience is that the average man in the fields pays little attention to the question of air gap.

"The fuse is used for protection against power currents. It is true that many fuses are destroyed by lightning, but the purpose of the fuse as a protective device is to keep power currents from the telephone apparatus and the buildings where they are installed. Telephone fuses are rated at their blowing point, while a light and power fuse is rated at its carrying point. In the Independent field the general practice is to use a 5-ampere fuse in cable terminals and 3-ampere fuse in substation protectors. Independent companies generally provide fuses and lighning arresters at the ends of their cables.

"The use of substation protectors is followed by some companies and not by others. We do not advise a substation protector with fuses on rural lines where there are no serious power hazards, but where such hazards exist, we believe the fuse should be used. We do not advocate the use of pole line arresters except in special places where there is some unusual hazard.

"In the central office, the standard practice is to use protectors provided with a heat coil and a lightning arrester. The heat coil is designed to protect against sneak currents.

Locating Cable Moisture

(Continued from page 37)

or a bridging ringer coil can be used for this.

On magneto exchanges, fifteen or twenty dry cells can be connected in series and a 500 ohm drop coil or ringer coil used for an impedance coil. The dry cells to take the place of the central office battery. One side of the battery is grounded and the other side is connected through the ringer coil to one side of the cable pair.

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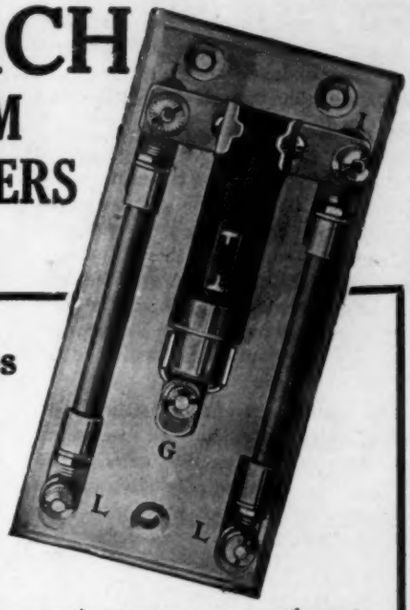

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The battery can be put on the cable pair and left overnight and in the morning the resistance to trouble will be much less than before the battery was connected.

By noting the drawing, a good idea may be obtained of the connections for this test. The battery current flows through the impedance coil and over the cable wire through the moisture to the armor and to ground. This battery current will not split at "A" and flow through the cable tester to ground, because of the arrangement of the cable tester circuit.

The battery current keeps the resistance of the water low, or we might say holds in the trouble until it can be located. It is usually advisable to have the sender operating only long enough to get a test, or until the fault has been limited to one span.

If the operator has any doubt as to whether the tone is going out over the cable pair or back into the battery, the exploring coil can be used at "A" to check the direction of the tone. It is always advisable to try on the cable just outside of the office, so as to know just what tone is going out over the cable pair.

On one occasion after a storm the writer has located three cases of water trouble in cables over two miles long, in less than three hours time, using a "Stewart" cable tester and this method.

In locating cable trouble sometimes things occur that look very puzzling at the time, but after the trouble is located are very simple.

Not long ago, the writer was called on long distance by a telephone manager about a case of trouble. He was using a Stewart cable tester and said the tone could be heard the whole length of the cable. The writer explained just how to make all the connections, being careful about every detail. The party calling said he thought he understood and would try it and call again.

That evening he called again. This time, to be sure, the writer had him explain just how he went about it. He was using the right method and had all connections right.

The writer then got a hunch and told him to take the whole outfit to the end of the cable and test back. He said he would, and that he would call up again.

He did not call that next day, so the writer figured no news was good news, but to make sure, called him. The manager laughed and admitted that the joke was on him, as the trouble was in the pot head at the end of the cable. In this case, of course, the tone could be heard the full length of the cable. This is just one of the many puzzling incidents that come up in the location of cable trouble.

Those not familiar with the exploring coil method of locating cable trouble may obtain bulletin describing this test by writing Stewart Bros., Ottawa, Ill. They also will be glad to give any information which they have on file.

Information covering the new Stewart cable tester will be furnished upon request.

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